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NATIONAL DAM SAFETY PROGRAM. BUFFALO RIVER NUMBER 3 (INVENTORY --ETC(U)
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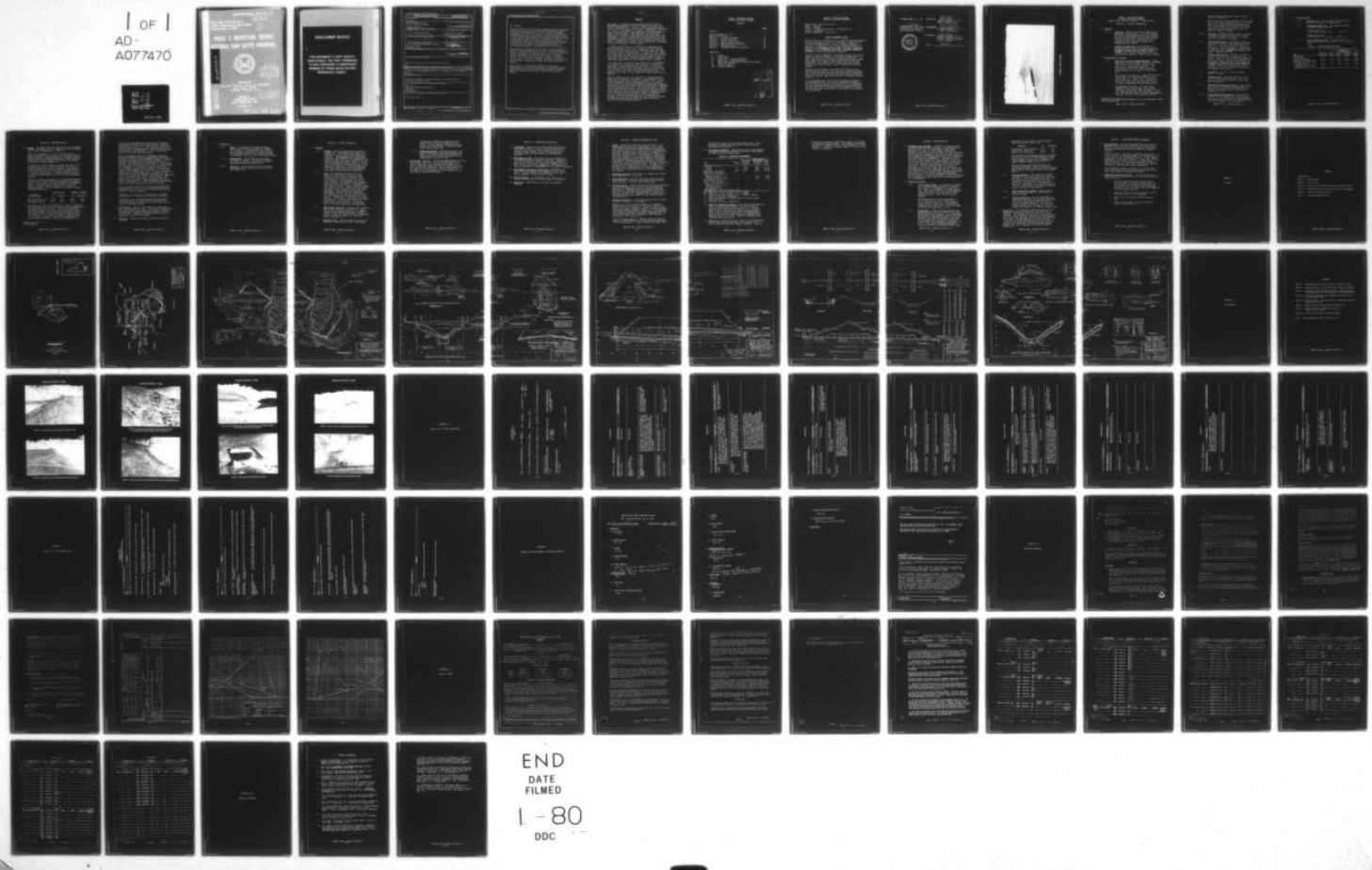

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JAMES RIVER BASIN

LEVEL III

Name of Dam: Buffalo River No. 3
Location: Amherst County, State of Virginia
Inventory Number: VA 00811

PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

PREPARED FOR
NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

PREPARED BY
MICHAEL BAKER, JR., INC.
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SEPTEMBER 1979

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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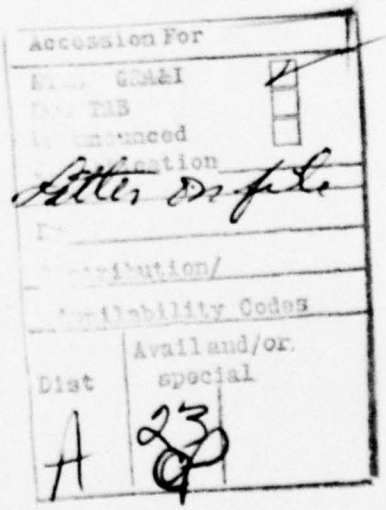

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Buffalo River No. 3
State: Virginia
County: Amherst
U.S.G.S. 7.5 Minute Quadrangle: Piney River, VA
Stream: Stonehouse
Date of Inspection: 24 May 1979

BRIEF ASSESSMENT OF DAM

Buffalo River No. 3 Dam is a zoned, earthfill dam approximately 500 feet long and 60 feet high. The dam, located on Stonehouse Creek approximately 7 miles northwest of Amherst, Virginia, is used for flood control. Buffalo River No. 3 Dam is an "intermediate" size - "high" hazard structure as defined by the Recommended Guidelines for Safety Inspection of Dams. Visual inspection and office analysis indicate no deficiencies requiring emergency attention.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the Probable Maximum Flood (PMF) was selected as the spillway design flood (SDF). The Soil Conservation Service (SCS) freeboard hydrograph (which establishes top of dam) is essentially equal to the PMF hydrograph. The spillways will essentially pass the PMF without overtopping the dam, and are therefore considered adequate.

The dam and appurtenant structures were found to be in generally good condition. No conditions indicating embankment instability were detected during the field inspection and office analyses. The safety factors determined during design are greater than those required for minimum accepted stability.

It is recommended that the following remedial measures be accomplished as part of the annual maintenance program: fill and seed the shallow erosion gullies on the embankment and in the emergency spillway, seed the vehicle tracks on the dam crest and the bare areas on the embankment, remove the driftwood from the shoreline, and install a staff gage in the reservoir.

MICHAEL BAKER, JR., INC.

Michael Baker, III, P.E.
Chairman of the Board and
Chief Executive Officer

SUBMITTED: Original signed by JAMES A. WALSH

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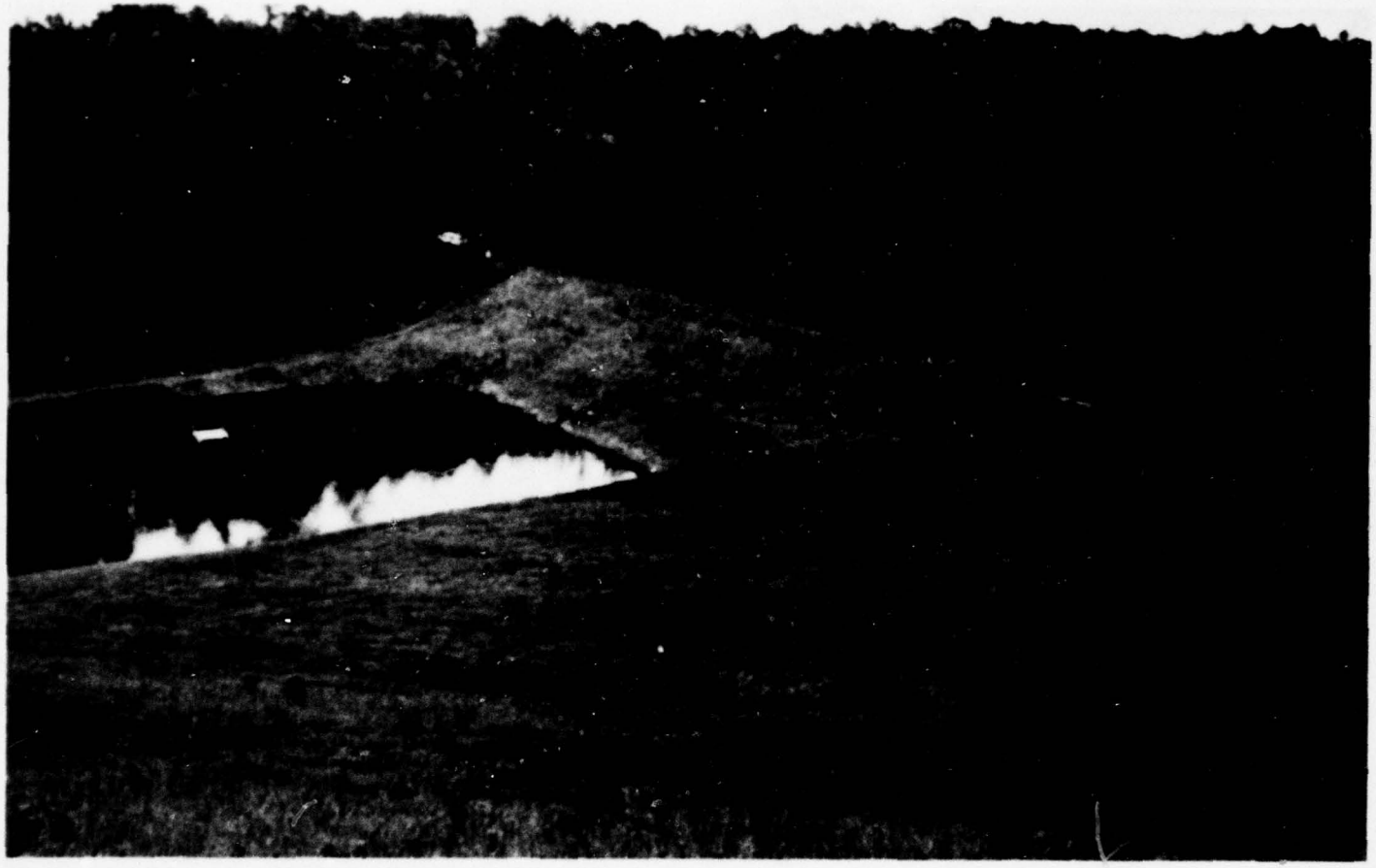
for Jack G. Starr
Chief, Engineering

APPROVED: Original signed by: Douglas L. Haller

Douglas L. Haller
Colonel, Corps of Engineers
District Engineer

Date: SEP 17 1979

NAME OF DAM: BUFFALO RIVER No. 3



OVERALL VIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: BUFFALO RIVER No. 3 ID# VA 00911

SECTION 1 - PROJECT INFORMATION

1.1 General

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army through the Corps of Engineers to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams. The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Description of Project

1.2.1 Description of Dam and Appurtenances: Buffalo River No. 3 Dam is a zoned, earthfill embankment approximately 60 feet high[1] and 500 feet long, with a crest width of 14 feet. The upstream and downstream slopes are 2.5:1 (horizontal to vertical) and the upstream slope changes to 3.5:1 below a 10 foot wide berm.

The principal spillway is a drop-inlet structure consisting of a reinforced concrete riser whose shaft is 2.5 feet wide, 7.5 feet long, and 30 feet high. The 30 inch reinforced concrete outlet pipe, approximately 336 feet in length, discharges into the outlet basin.

The emergency spillway, a 250 foot wide, vegetated earth side channel with a crest elevation of 702.1 feet Mean Sea Level (M.S.L.), is located outside the right[2] abutment of the dam. The approach channel slope is approximately 2 percent to the 30 foot long level control

[1]Measured from downstream embankment toe to the embankment crest.
[2]Facing downstream.

section and the discharge slope is approximately 2.5 percent.

The riser, with a crest elevation of 686.0 feet M.S.L., maintains the normal pool. A 30 inch pond drain, with a manually operated sluice gate, is provided at the bottom of the riser at invert elevation 656.0 feet M.S.L. The plan and typical sections of the dam are shown in Plates 2 through 6.

1.2.2 Location: Buffalo River No. 3 Dam is located on Stonehouse Creek approximately 7 miles northwest of Amherst, Virginia. A Location Plan is included in this report.

1.2.3 Size Classification: The maximum height of the dam is 60 feet and the reservoir storage capacity to the top of dam (elevation 712.4 feet M.S.L.) is 2474 acre-feet. Therefore, the dam is in the "intermediate" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

1.2.4 Hazard Classification: The dam is located in a rural area where failure may result in possible loss of life and damage to homes and crops. Therefore, this dam is considered in the "high" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams. The hazard classification used to categorize dams is a function of location only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: The dam is owned by Amherst County, Virginia.

1.2.6 Purpose of Dam: The dam is used for flood control within Amherst County. The County also has plans for recreational use of the dam and reservoir.

1.2.7 Design and Construction History: The existing facility was designed by the Department of Agriculture, Soil Conservation Service (SCS). The dam, completed in 1978, was built by Itayme Bros., Inc.

1.2.8 Normal Operating Procedures: The reservoir is maintained at normal pool elevation 686.0 feet M.S.L. No formal operating procedures are followed for the dam. For a more detailed operating assessment, see paragraph 4.1.

1.3 Pertinent Data

1.3.1 Drainage Area: The drainage area for Buffalo River No. 3 Dam is 4.99 square miles.

1.3.2 Discharge at Dam Site: The maximum discharge at the dam site is unknown.

Principal Spillway:
Pool level at top of dam . . 138 c.f.s.

Emergency Spillway:
Pool level at top of dam . . 14,795 c.f.s.

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet M.S.L.	Reservoir Capacity: Area acres	Acre-feet	Watershed inches	Length feet
Top of dam	712.4	125	2474	9.30	6700
Maximum pool, design surcharge	705.5	102	1711	6.43	6700
Emergency spillway crest	702.1	91	1397	5.25	5700
Principal spillway crest (normal pool)	686.0	41	374	1.41	3000
Streambed at downstream toe of dam	652.0	-	-	-	-

SECTION 2 - ENGINEERING DATA

2.1 Design: The subsurface investigation and the embankment design were made by the SCS. Reports of their findings are included in Appendices VI and VII.

There was a maximum of 7.5 feet of clayey, silty, sandy, and gravelly alluvium (CL, ML, SM, GM) overlying granite bedrock on the floodplain of Stonehouse Creek. Because the shear strength parameters of these deposits were uncertain, the material was excavated to bedrock to provide a stable foundation.

The residual silty and sandy soils (ML, MH, SM) on the abutments vary up to 6 feet in thickness overlying highly weathered and fractured granite. Test borings drilled between Stations 2+00 and 3+00 penetrated a 0.2 to 0.3 foot thick void in the granite between 12 and 17 feet below the surface. A deep cut-off trench was provided to extend below the void and highly permeable bedrock.

Three soil samples representative of emergency spillway and borrow pit excavations were analyzed in the laboratory to obtain shear strength parameters for embankment design. Consolidated undrained triaxial tests were made on saturated samples, remolded to 95 percent standard density. The following are the shear strength parameters obtained:

Unified Classification	Total Stress		Effective Stress	
	ϕ	c(p.s.f.)	$\bar{\phi}$	$\bar{c}$(p.s.f.)
ML (non-plastic silt)[3]	18.5°	1700	35.0°	50
MH (plastic silt)[4]	14.5°	1400	30.5°	300
ML (plastic silt)[4]	16.0°	800	34.5°	75

The Typical Section for Compacted Fill shown on the as-built drawings (see Plate 4) indicates that the embankment was constructed of two zones, as were the embankments analyzed for stability. Zone I, the central core, cut-off trench backfill, and foundation excavation backfill, was constructed of plastic silty material (MH and ML). Non-plastic silty soil (ML) was used to construct Zone II, the shell. All material was to be compacted to 95 percent maximum density. The slope configuration of

[3]Shell material.
[4]Core materials.

the as-built embankment was essentially the same as that analyzed for stability during design. The downstream slope ratio is 2.5:1 with a 10 foot wide berm at elevation 688.0 feet M.S.L.; the upstream slope ratio from the toe of the embankment to the 10 foot wide berm at elevation 686.5 feet M.S.L. is 3.5:1; above the berm, a 2.5:1 slope was constructed.

The SCS performed a series of embankment stability analyses using the effective stress shear parameters previously listed for the embankment material. Stability was analyzed using both the Bishop and Swedish Circle Methods. The zoning and slope configuration were virtually the same as that constructed. It was assumed that the alluvial foundation soil would be removed from the floodplain. This was done during construction. Full drawdown conditions were assumed for the upstream slope; steady seepage, with a drain at c/b = 0.6 was assumed for the downstream slope. The resulting minimum safety factors for the upstream slope were 1.35 and 1.41 for the Bishop and Swedish Circle Methods respectively. The minimum safety factors for the downstream slope were 2.1 and 1.98 respectively for the Bishop and Swedish Circle Methods. These downstream slope safety factors decreased to 1.55 and 1.46 when an acceleration factor of 0.1G was applied for seismic analysis.

A 20 to 40 foot wide cut-off trench was constructed on both abutments through soil and highly weathered and permeable bedrock. This cut-off extended through the void(s) in the left abutment.

An overfill of one foot was constructed to provide compensation for residual and foundation settlement.

Toe drains were constructed beneath the downstream embankment slope of coarse and fine aggregate and 6 inch perforated corrugated metal pipe; these drains outlet in the impact basin.

2.2 Construction: The dam, constructed by Itayme Bros., Inc., was completed in 1978. Construction records were not available for this inspection; however, as-built drawings were reviewed and were subsequently verified in the field. Construction reports are on file in Washington, District of Columbia.

2.3 Operation: There are no formal operating records for this dam.

2.4 Evaluation

2.4.1 Design: The as-built drawings and Design Report were available to assess all aspects of the design. The hydrologic and hydraulic data provided was adequate for design review. The assessments made in this report are based on the design data along with field observations.

2.4.2 Construction: No construction logs were available for review. The as-built drawings indicate any changes or modifications that were made during the construction.

2.4.3 Operation: Annual operation and maintenance inspection reports were available for review (see Appendix V).

SECTION 3 - VISUAL INSPECTION

3.1 Findings

3.1.1 General: The field inspection was made on 24 May 1979. The weather was cloudy with a temperature of 65°F and ground conditions were dry. The reservoir was at normal pool elevation. The embankment and appurtenant structures were found to be in generally good condition except for some erosion gullies and vehicle tracks (see Photos 3 and 7). Plate 1 is a Field Sketch of conditions found at the time of the inspection. The complete visual inspection check list is given in Appendix III. The following are brief summaries of conditions found during the inspection.

3.1.2 Dam: The embankment was found to be in generally good condition with no slumps, bulges, or other signs of movement. The cross-section of the dam along the axis of the principal spillway agrees with the as-built drawings. The embankment has adequate grass cover but the grass is interspersed with tall dead woody stalks in numerous areas (see Photos 1 and 2). Shallow erosion gullies have developed on the downstream slope above the bench. Small erosion gullies have also developed on the upstream and downstream embankments adjacent to the rock gutters on the right end of the dam (see Photo 3) and at the left abutment on the upstream slope (see Plate 1). No movement, sloughing, or cracking was observed in the vicinity of the toe. No seepage areas were observed. There is a minor amount of driftwood on the upstream shore. An access road runs along the crest.

3.1.3 Appurtenant Structures: The principal spillway was in good condition (see Photo 6). Small erosion gullies were observed in the approach channel of the emergency spillway. Several vehicle tracks are located across the emergency spillway and up the right cut slope (see Plate 1 and Photo 7).

3.1.4 Reservoir Area: No serious deficiencies were observed in the reservoir area. The slopes

are gentle to moderately steep and mostly wooded except for grassy areas near the shore. A staff gage and recorder should be installed in the reservoir to monitor water levels above normal pool.

3.1.5 Downstream Channel: The stilling basin and outlet channel are functioning properly (see Photo 8). A small stream flows through the stone riprap into the stilling basin from a wooded gully on the left side.

3.2 Evaluation: Generally, the dam and appurtenant structures are in good condition. Erosion gullies and vehicle tracks should be filled with earth and seeded. The small stream which flows through the stone riprap into the stilling basin apparently has no adverse affects on the stability of the riprap. The minor amount of driftwood on the upstream shore can be removed during the regular maintenance program.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: There are no formal operating procedures for Buffalo River No. 3 Dam. The water level in the reservoir is maintained by the crest of the riser. During periods of heavy inflow, the excess water is diverted around the dam by means of the emergency spillway.

4.2 Maintenance of Dam: The owner has the responsibility for operation and maintenance of the dam. Inspections, with the assistance of the SCS, have been performed annually for the past two years since completion of the dam. During these visual inspections (see Appendix V), remedial measures are recommended for corrective maintenance.

4.3 Maintenance of Operating Facilities: Maintenance of the operating equipment is the responsibility of the owner. The only operational equipment on this dam is the lift pedestal, stem, and sluice gate.

4.4 Warning Systems: At the present time, there is no formal warning system or evacuation plan in operation.

4.5 Evaluation: Maintenance of the dam is considered adequate.

SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

5.1 Design: Normal pool (elevation 686.0 feet M.S.L.) is maintained by the crest of the concrete riser. The riser crest elevation was established at an elevation sufficient to store the 100-year sediment accumulation. The crest (elevation 702.1 feet M.S.L.) of the emergency spillway was established at the elevation needed to store the 100-year flood. The elevation of the top of dam (712.4 feet M.S.L.) was established by the maximum elevation reached in routing the freeboard hydrograph. The freeboard hydrograph is that computed from rainfall comparable to Probable Maximum Precipitation (PMP) as used by the Corps of Engineers and is therefore comparable to the Probable Maximum Flood (PMF). The PMF is an estimate of flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in a region.

5.2 Hydrologic Records: No rainfall or stream flow records were available at the dam site.

5.3 Flood Experience: No exact high water marks or dates were available. However, the maximum known reservoir level was only 1 or 2 feet above normal pool.

5.4 Flood Potential: Design features of the dam and reservoir were established by the SCS by routing the principal spillway, the emergency spillway, and the freeboard hydrographs. Hydrograph data was determined by using the SCS - National Engineering Handbook - Chapter 4, Hydrology (Reference 7, Appendix VIII) with the time of concentration and curve numbers established by basin characteristics.

5.5 Reservoir Regulation: Pertinent dam and reservoir data is shown in Table 1.1, paragraph 1.3.3.

Regulation of flow from the reservoir is automatic. Normal flows are maintained by the riser crest at an elevation of 686.0 feet M.S.L. Water flowing over the riser crest passes through the dam in a 30 inch diameter reinforced concrete conduit. Water also flows past the dam through the ungated, vegetated, emergency spillway in the event water in the reservoir rises above an elevation of 702.1 feet M.S.L.

Outlet discharge capacity, reservoir area and storage capacity, hydrograph data, and routings were taken from the SCS Design Report. Flood routings were begun with

the reservoir level 0.4 feet above normal pool. Outlet discharge includes discharge from both the principal and emergency spillways.

5.6 Overtopping Potential: The probable rise of the reservoir and other pertinent information on reservoir performance are shown in the following table:

TABLE 5.1 RESERVOIR PERFORMANCE

Item	Normal	Hydrographs		
		Principal Spillway (a)	Emergency Spillway (b)	Free-board (c)
Peak flow, c.f.s.				
Inflow	5	3608	5842	19,185
Outflow	5	125	2400	14,933
Peak elev., ft. M.S.L.	686.0	702.1	705.5	712.43
Emergency spillway(d) (elev. 702.1 feet M.S.L.)				
Depth of flow, ft.	-	-	2.3	6.9
Average velocity, f.p.s.	-	-	8.5	14.9
Duration of flow, hrs.	-	-	11.7	14.9
Non-overflow section (elev. 712.4 feet M.S.L.)				
Depth of flow, ft.	-	-	-	-
Average velocity, f.p.s.	-	-	-	-
Total duration of overtopping, hrs.	-	-	-	-
Tailwater elev., ft. M.S.L.(e)	652.4	-	-	-

(a) Based on a 24 hour rainfall of 8.9 inches.
(b) Based on a 6 hour rainfall of 12.0 inches.
(c) Based on a 6 hour rainfall of 27.9 inches - PMF by Corps of Engineers' standards.
(d) Depth and velocity estimates based on critical depth control section.
(e) Tailwater at time of inspection.

5.7 Reservoir Emptying Potential: The time for the reservoir level to automatically decrease from the emergency spillway crest (elevation 702.1 feet M.S.L.) to the riser crest (elevation 686.0 feet M.S.L.) is approximately 6 days. The reservoir may be dewatered from riser crest elevation (normal pool) in approximately 3 days by use of the 30 inch sluice gate located on the upstream face of the riser. Reservoir drawdowns were computed neglecting inflow.

5.8 Evaluation: Buffalo River No. 3 Dam is an "intermediate" size - "high" hazard dam requiring evaluation for a spillway design flood (SDF) equal to the PMF. The SCS

freeboard hydrograph is essentially equal to the Corps of Engineers' PMF hydrograph. The freeboard hydrograph was used to establish the top of dam elevation of 712.4 feet M.S.L. Therefore, the spillways will pass the PMF without overtopping.

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: Foundation conditions were obtained from laboratory analyses, field observations, and boring and test pit information. There was a maximum of 7.5 feet of silty, sandy, and gravelly alluvium consisting of sand (SM) and silt (ML) overlying granite on the floodplain. The silty alluvial soils on the floodplain were removed to provide a firm foundation; the foundation of the embankment is therefore granite bedrock of variable permeability. Residual soils in the lower right abutment are comprised of 1 to 4.5 feet of silt (MH, ML) which increases in depth considerably over highly weathered and fractured bedrock at higher elevations. The left abutment has 5 to 6 feet of residual silts and silty sands (ML, SM) overlying a 22 foot deep zone of highly weathered granite. Due to the high permeability of the weathered and fractured granite, particularly in the abutment areas, seepage control is provided by a cut-off trench through the permeable zones of bedrock. Additional seepage control is provided by a foundation drainage system on the downstream side of the embankment.

6.2 Stability Analysis

6.2.1 Visual Observations: No evidence of movement, i.e., bulging, tension cracks, or slumping, was noted on the embankment or beyond the toe. There do not appear to be deficiencies other than erosion gullies on three abutment slopes and above the 10 foot berm on the downstream slope. There was no visible seepage.

The downstream slope was constructed to a 2.5:1 ratio with a 10 foot wide berm at elevation 688.0 feet M.S.L. The upstream slope, from the toe to the 10 foot berm at elevation 686.5 feet M.S.L., is 3.5:1; above the berm the slope ratio is 2.5:1.

6.2.2 Design Data: Slope stability analyses were performed using both the Swedish Circle and Bishop Methods of analyses. A full drawdown was assumed on the upstream slope with steady seepage on the downstream slope. The data for the slope stability analyses with other soils and geologic information from the Design Report are presented in Appendices VI or VII. The following embankment shear strength parameters (effective stress) were

used based on the results of consolidated undrained triaxial shear tests:

Material	Ø	c(p.s.f.)
Non-plastic silt (ML)-shell	35.0°	50
Plastic silt (MH)-core	30.5°	300
Plastic silt (ML)-core	34.5°	75

The analysis of the maximum section at Station 3+85 for the upstream slope showed a minimum safety factor of 1.35 at full drawdown. The steady seepage analysis of the downstream slope yielded a safety factor of 2.1.

Toe drains were constructed beneath the downstream embankment slope of coarse and fine aggregate and 6 inch perforated corrugated metal pipe; these drains outlet in the impact basin.

6.2.3 Operating Records: The inspection reports for the past two years indicate no serious problems. It was noted that water flows down the side of the rock gutter on the left downstream slope and that there are erosion gullies in the approach of the emergency spillway. Apparently, new growth is forming in the vehicle tracks on the spillway and cut slope, as noted in the reports.

6.2.4 Post-Construction Changes: There were no known alterations made to the dam since it was constructed.

6.2.5 Seismic Stability: The SCS, subsequent to performing the stability analyses previously discussed, applied an acceleration factor of 0.1G to the downstream slope in order to evaluate seismic stability. The resulting safety factors were 1.55 and 1.47 for the Bishop and Swedish Circle Methods respectively.

6.3 Evaluation: The embankment section selected for the stability analyses is compatible with the as-built drawings. The unstable silty alluvial soils were removed in the floodplain to provide a firm foundation. The minor erosion gullies observed on the downstream slope and at the abutments do not affect the stability of the dam. The dam appears to be in good stable condition; the stability analyses show that both the upstream and downstream slopes have safety factors greater than those required for minimum acceptable stability.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: The dam and appurtenant structures are generally in good overall condition. No deficiencies were discovered during the field inspection and office analyses which would indicate the need for emergency attention.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the PMF was selected as the SDF for the "intermediate" size - "high" hazard classification of Buffalo River No. 3 Dam. The freeboard hydrograph, as computed by the SCS, is essentially equal to the PMF. The freeboard hydrograph is used to establish the minimum top of dam elevation and therefore the dam will pass the PMF without overtopping.

The recommended remedial measures are not considered urgent and therefore may be accomplished as part of the annual maintenance and inspection program.

7.2 Recommended Remedial Measures: The following repair items should be completed as part of the general maintenance of the dam:

1) Fill and seed the shallow erosion gullies above the bench on the downstream slope, on the upstream left abutment, adjacent to the rock gutters at the upstream and downstream abutment on the right side, and on the approach to the emergency spillway.

2) Seed the vehicle tracks on the crest and the small bare areas on the embankment.

3) Remove the scattered driftwood on shore of dam.

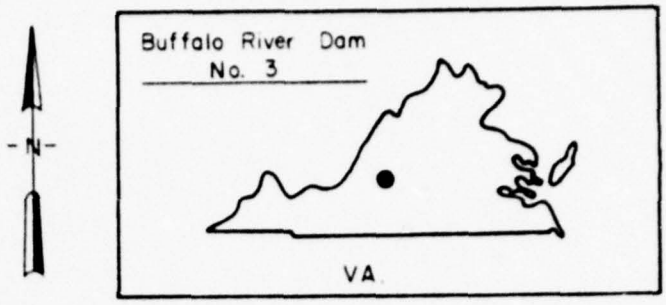
4) Install a staff gage to monitor reservoir levels above normal pool.

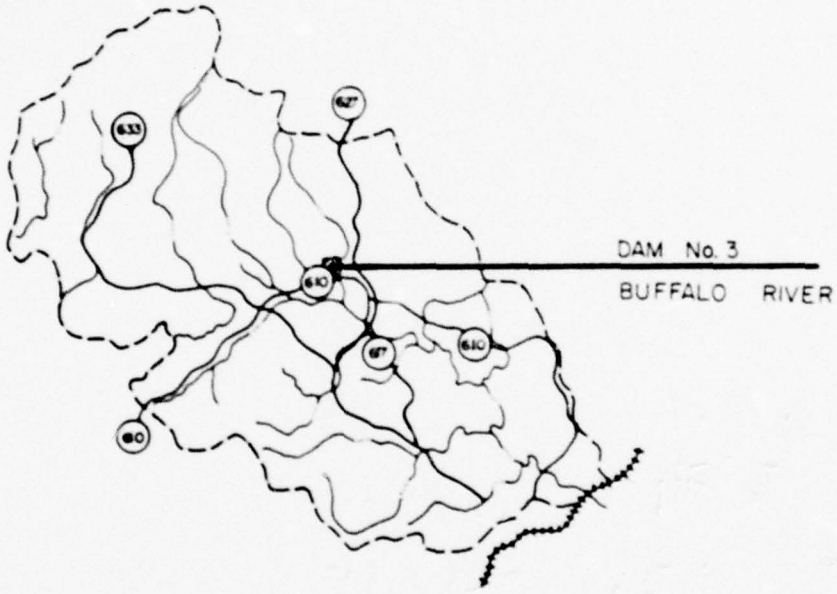
APPENDIX I

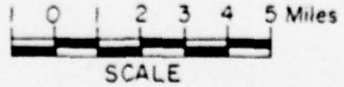
PLATES

CONTENTS

NAME OF DAM: BUFFALO RIVER No. 3

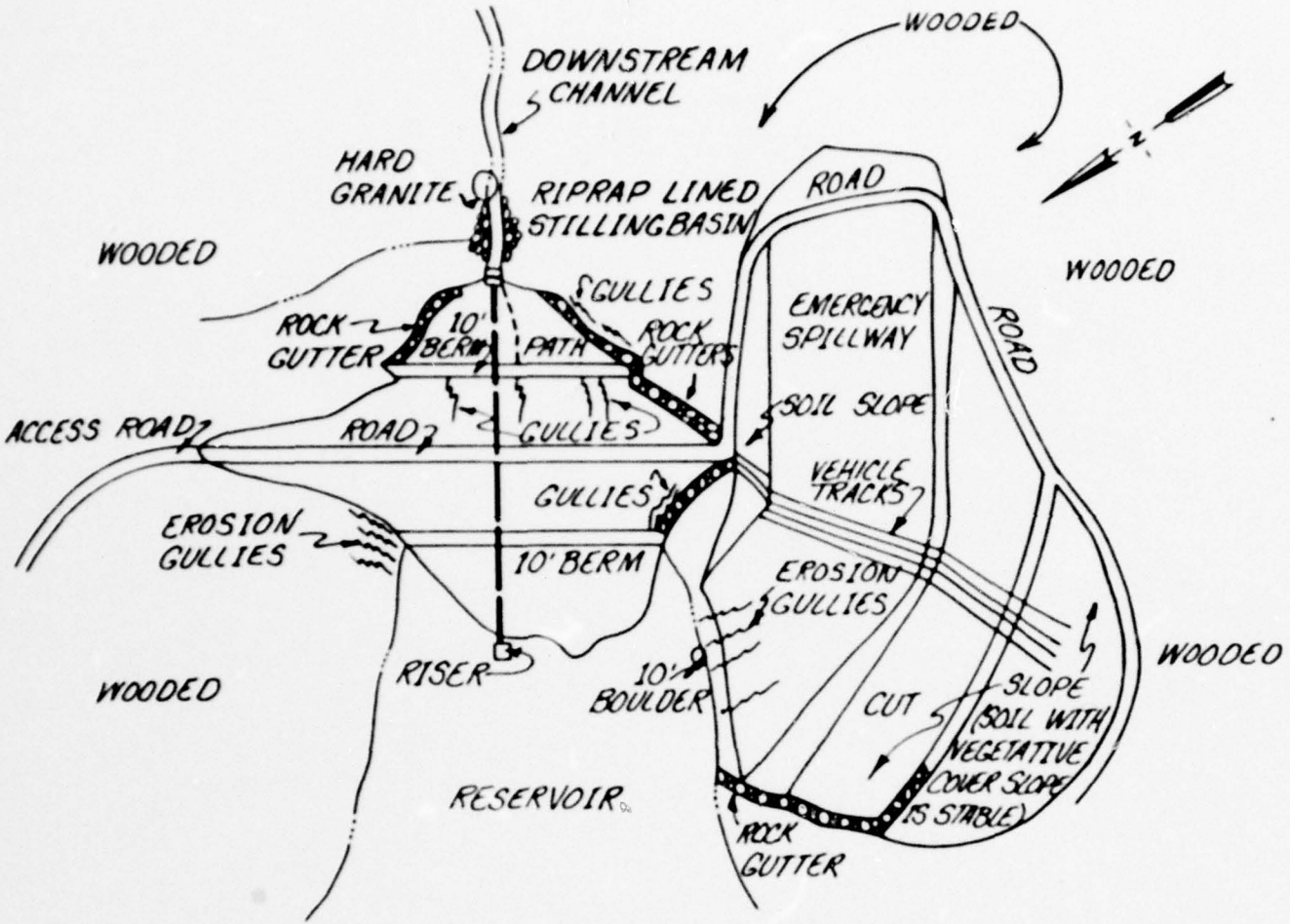






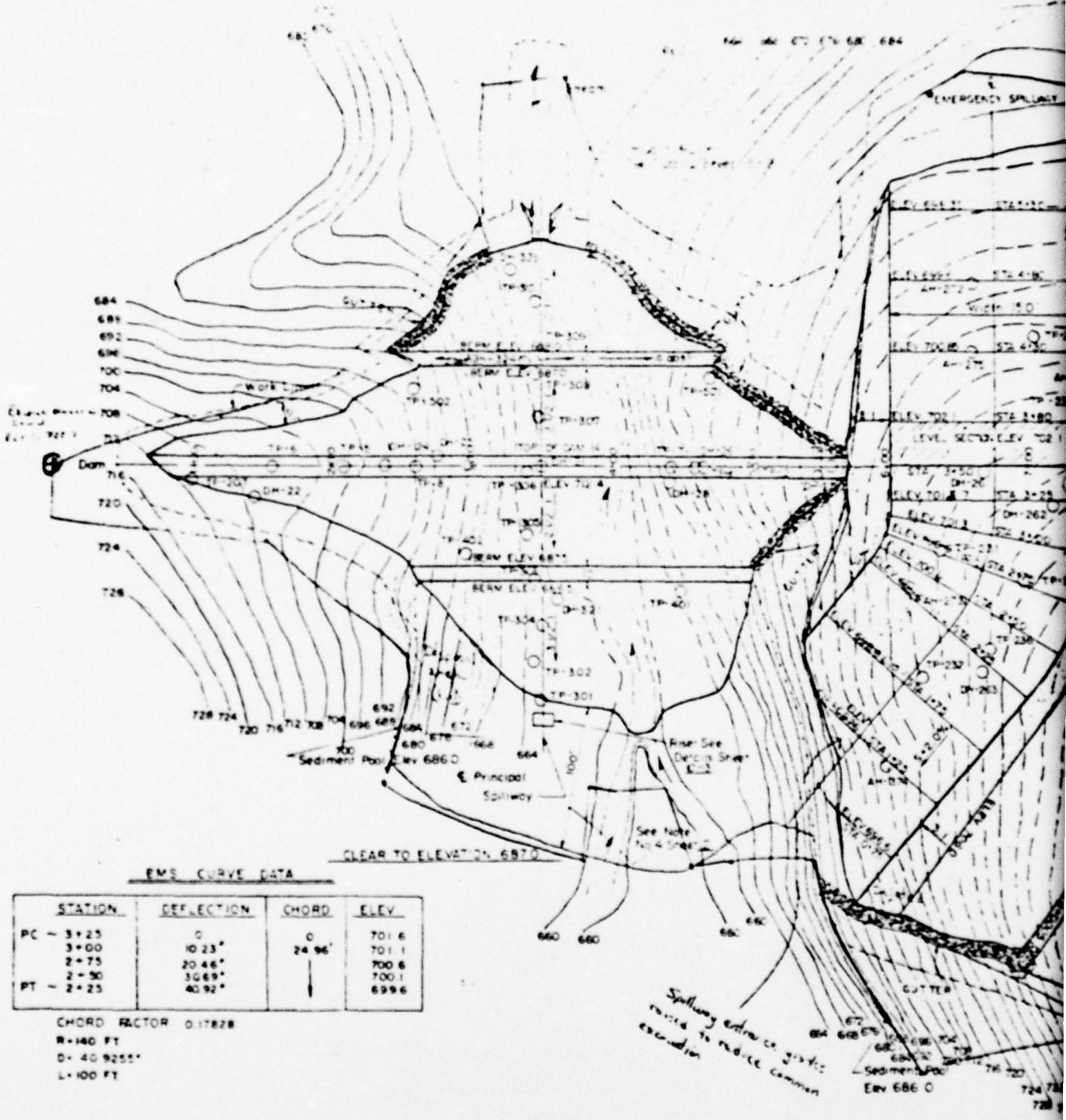
LOCATION PLAN

BUFFALO RIVER DAM
NO. 3



(NO SCALE)

FIELD SKETCH
BUFFALO RIVER
DAM No. 3
Michael Baker, Jr., Inc.
July 1979
PLATE I

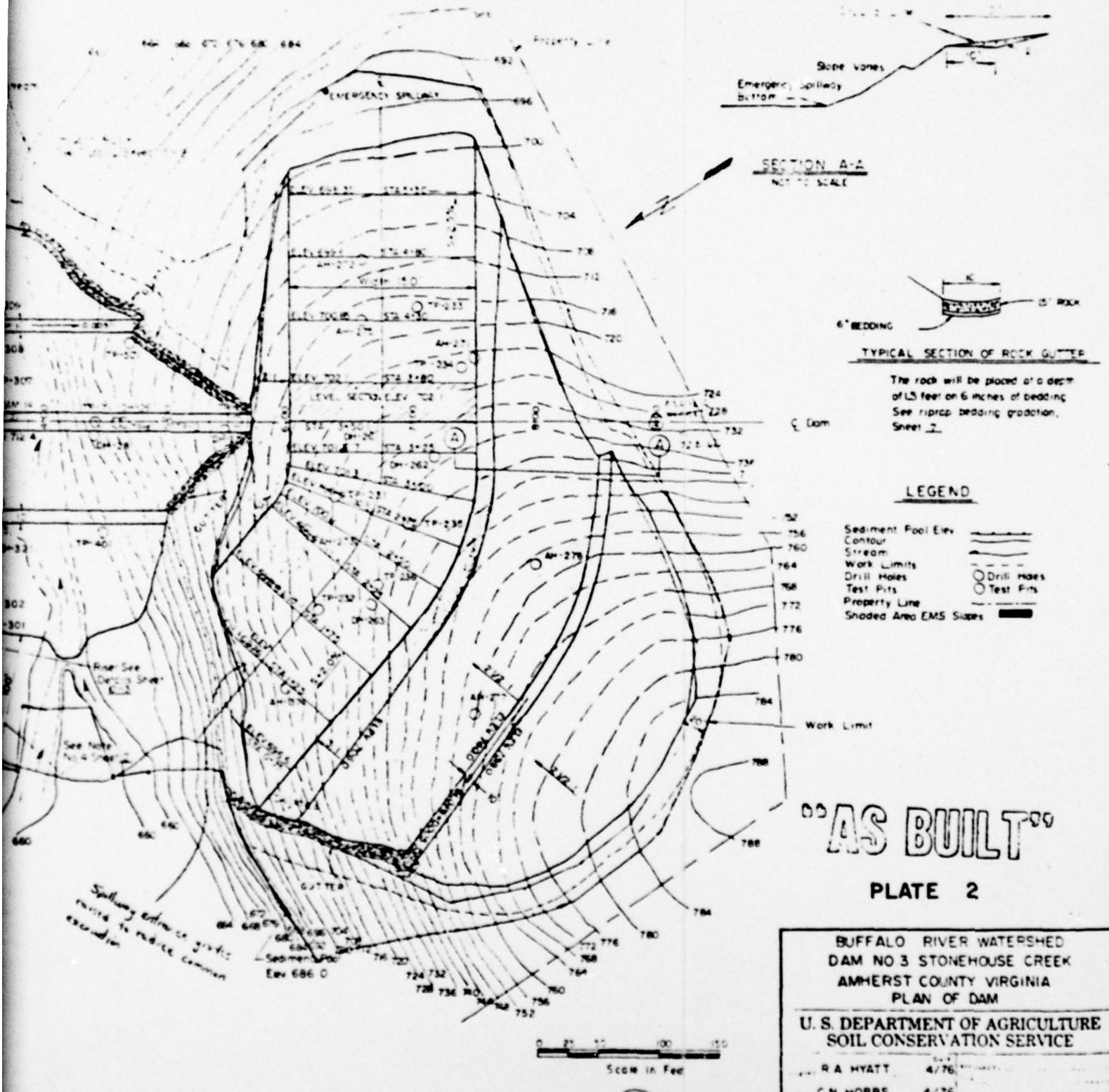


EMS CURVE DATA

STATION	DEFLECTION	CHORD	ELEV
PC ~ 3+25	0	0	701.6
3+00	10 23'	24.96'	701.1
2+75	20 46'		700.6
2+50	30 69'		700.1
PT ~ 2+25	40 92'		699.6

CHORD FACTOR 0.17828
R=140 FT
D= 40.9255°
L=100 FT

1



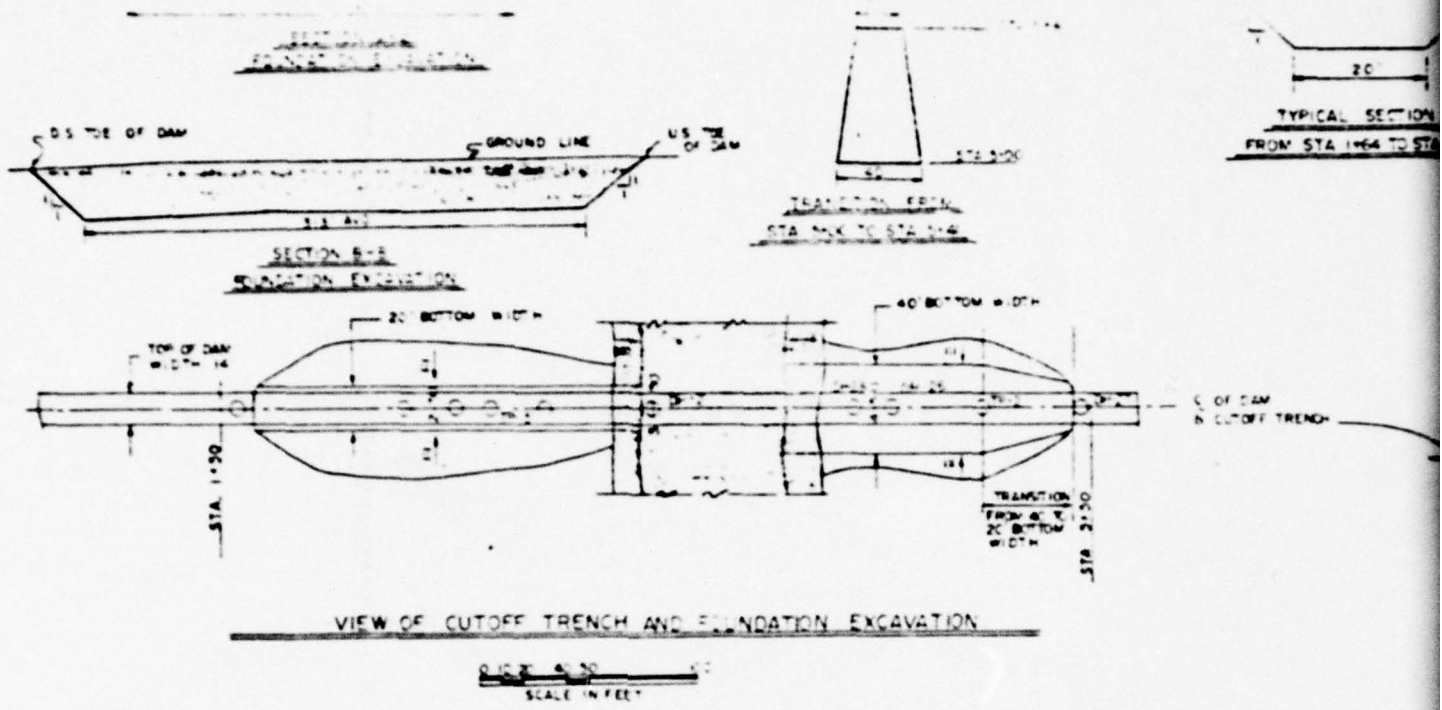
"AS BUILT"

PLATE 2

BUFFALO RIVER WATERSHED
DAM NO 3 STONEHOUSE CREEK
AMHERST COUNTY VIRGINIA
PLAN OF DAM

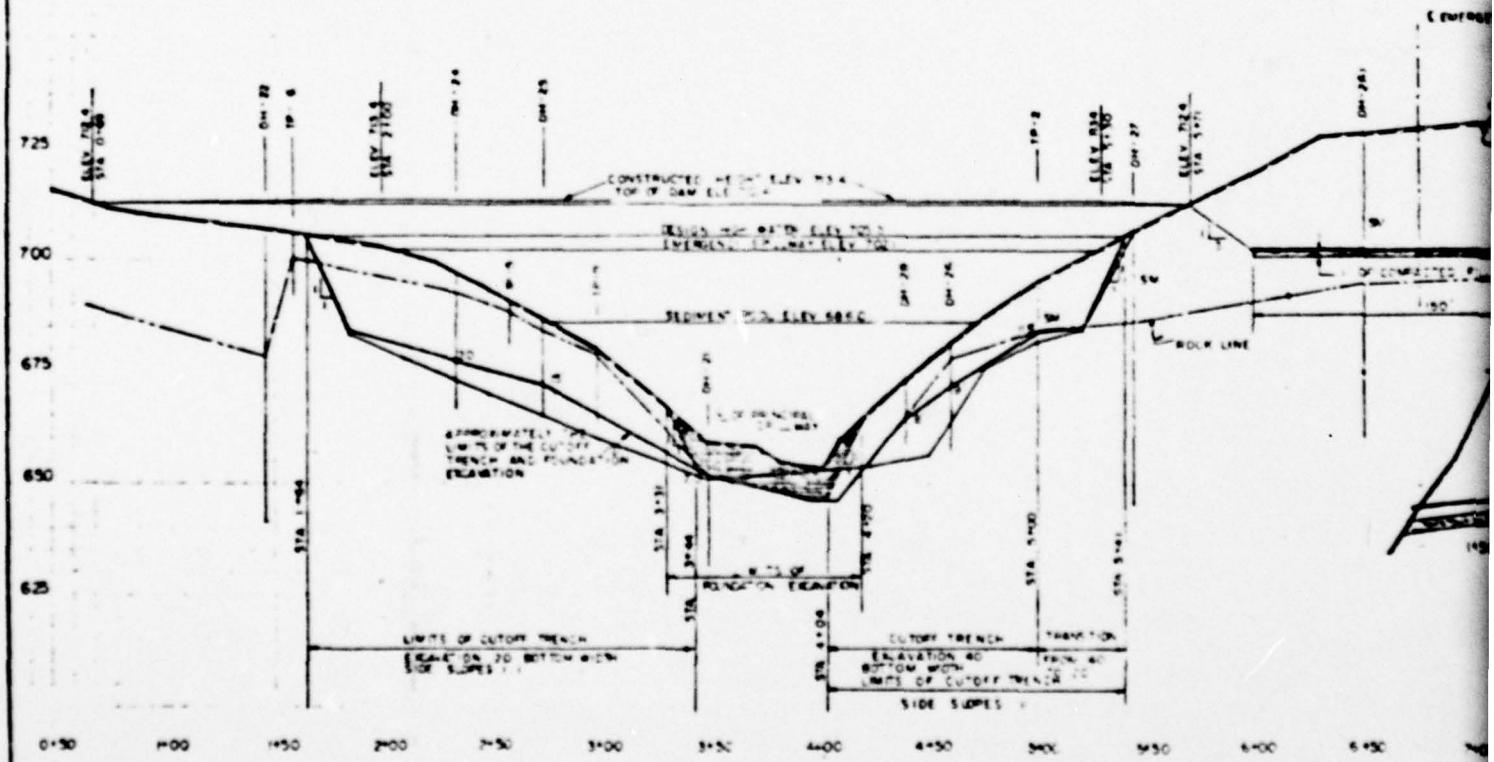
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

R A HYATT 4/76
C N HOBBS 4/76
7/76
VA-1003-P



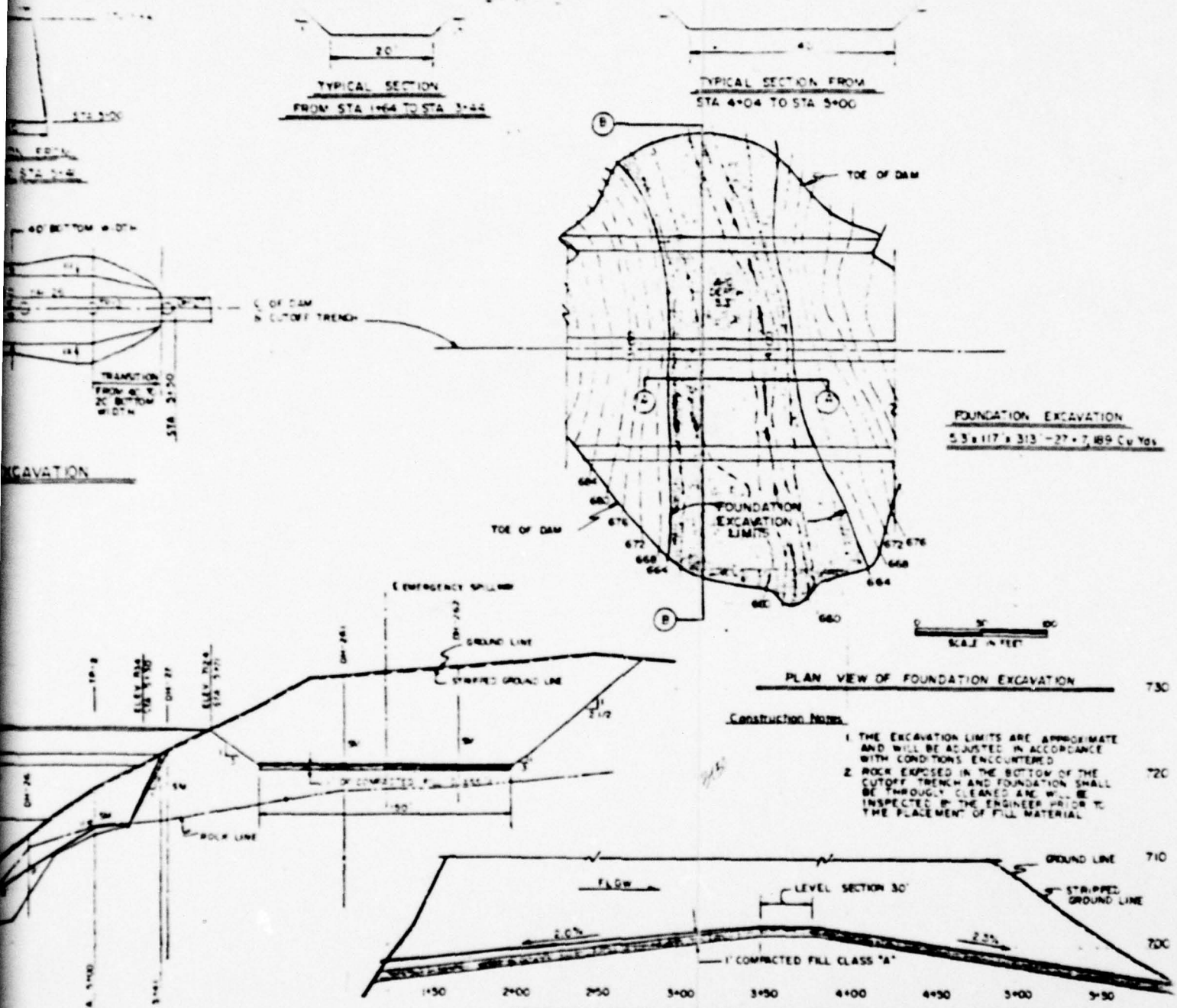
VIEW OF CUTOFF TRENCH AND FOUNDATION EXCAVATION

SCALE IN FEET



PROFILE OF CUTOFF TRENCH AND FOUNDATION EXCAVATION

1



"AS BUILT"

PLATE 3

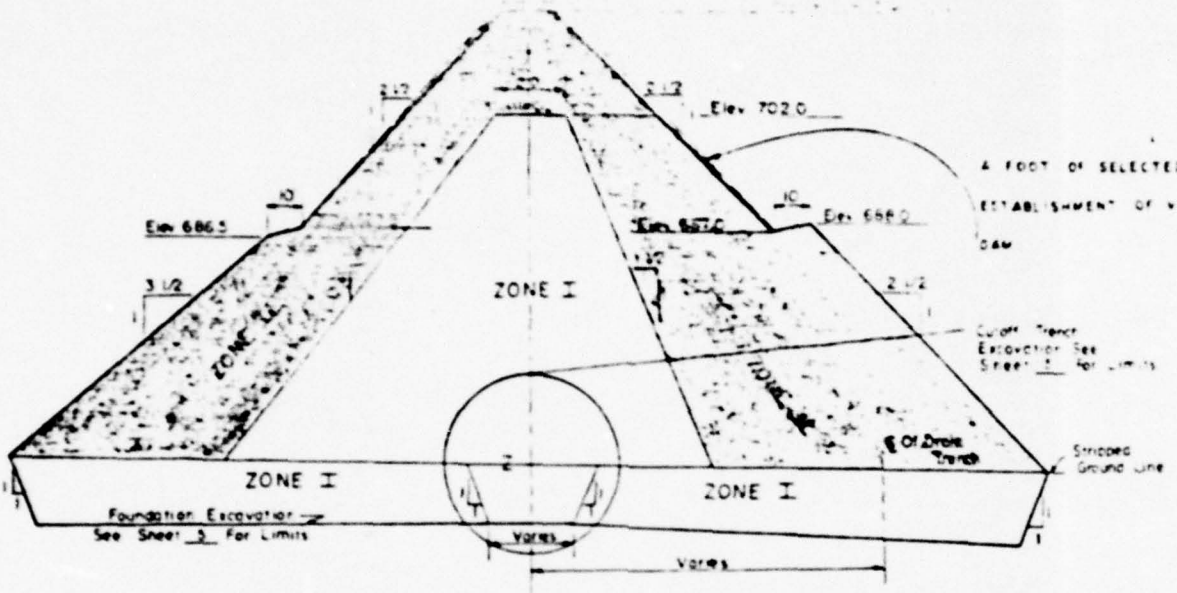
BUFFALO RIVER WATERSHED
DAM NO 3 STONEHOUSE CREEK
AMHERST COUNTY, VIRGINIA
PLAN OF CUTOFF TRENCH AND FOUNDATION EXCAVATION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

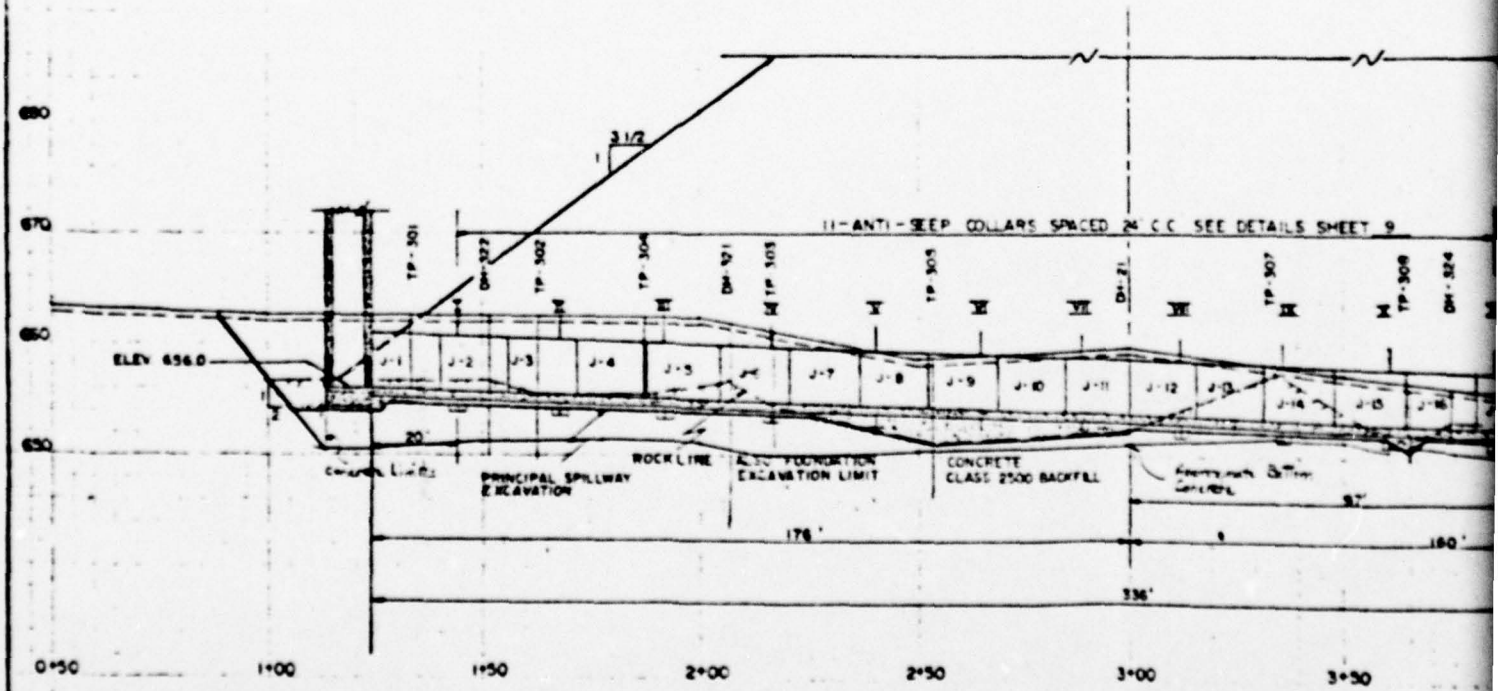
R A HYATT 5/76
C N HOBBS 6/76

VA-1003-P

1 2



TYPICAL SECTION OF COMPACTED FILL



1

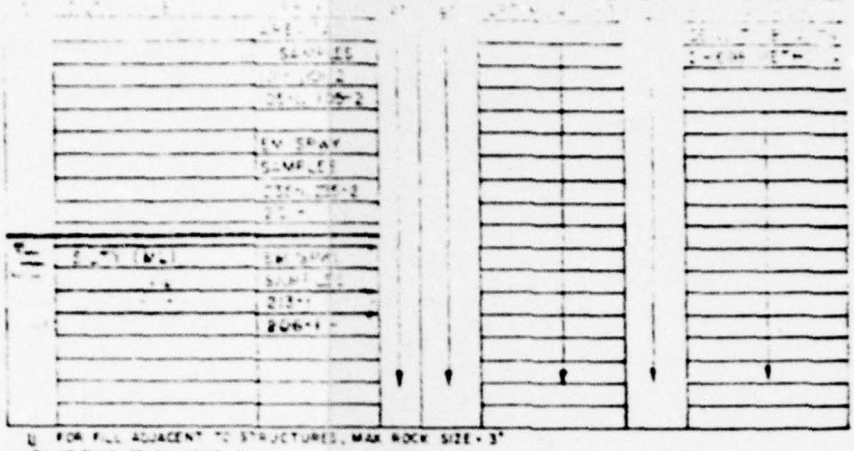
A FOOT OF SELECTED MATERIAL FOR

ESTABLISHMENT OF VEGETATION ON FACE OF

DAM

Cutoff Trench Excavation See Sheet ___ for Limits

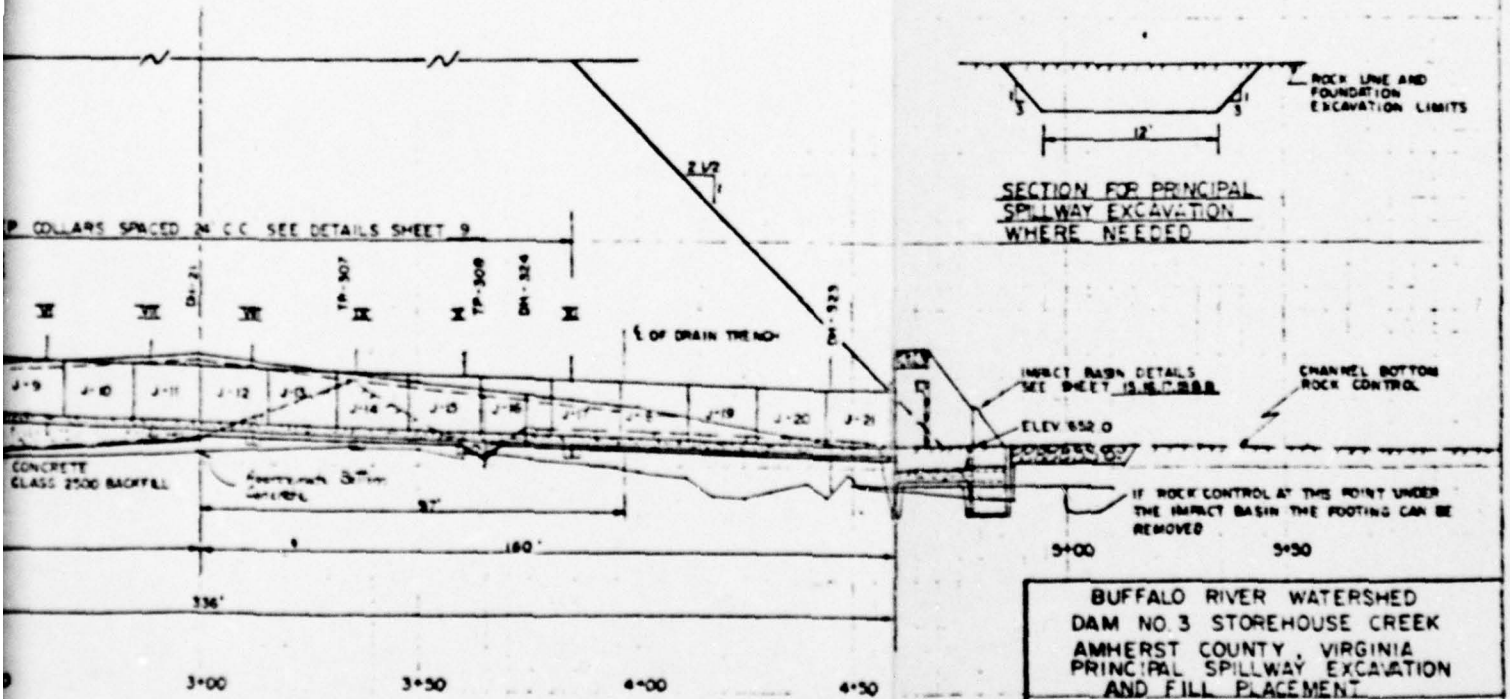
Existing Ground Line



1/ FOR FILL ADJACENT TO STRUCTURES, MAX ROCK SIZE = 3"
2/ AT TIME OF PLACEMENT
3/ FOR TYPICAL COMPACTION CURVES SEE SHEET 25

Use Plastic Material from Borrow Area "A" & Em Spwy In Zone I Core, Cutoff Trench & Foundation Excavation

Use Non-Plastic Material From Em Spwy In Zone II, Shell Of Embankment



SECTION FOR PRINCIPAL SPILLWAY EXCAVATION WHERE NEEDED

BUFFALO RIVER WATERSHED
DAM NO. 3 STOREHOUSE CREEK
AMHERST COUNTY, VIRGINIA
PRINCIPAL SPILLWAY EXCAVATION AND FILL PLACEMENT

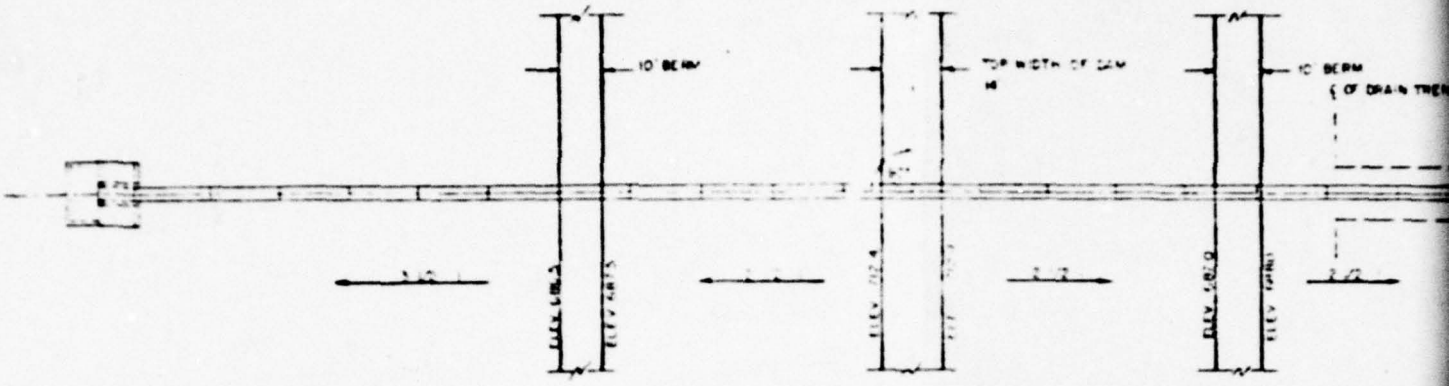
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

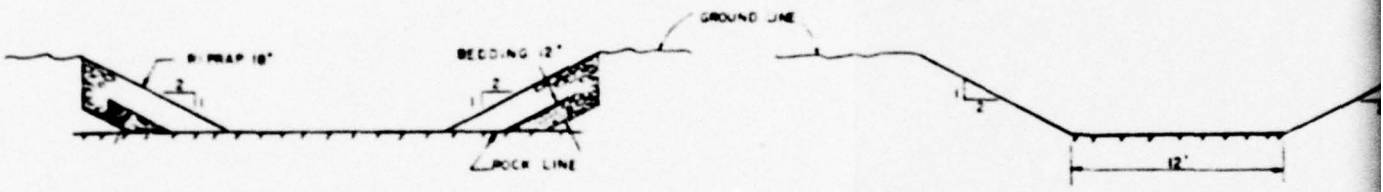
Designed	R.A. HYATT	5/76
Drawn		
Traced	C.N. HOBBS	6/76
Checked		7/76

VA-1003-P

"AS BUILT"

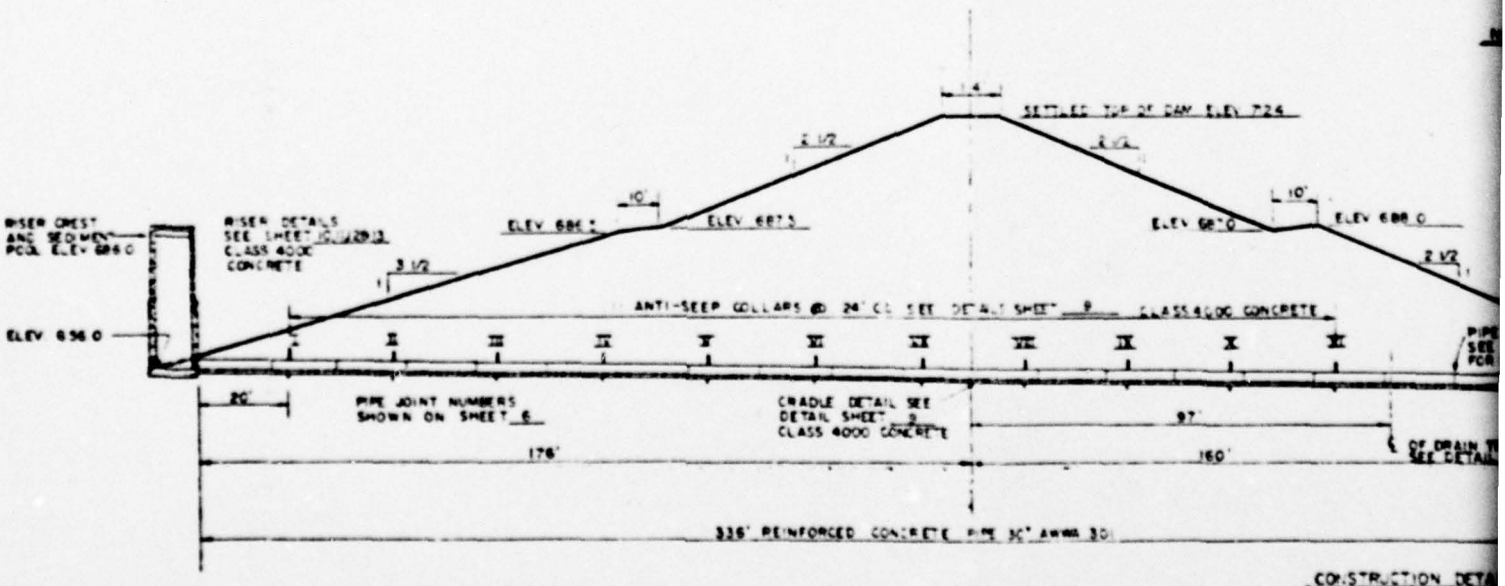
PLATE 4





SECTION A-A

SECTION B-B



PROFILE ALONG ℄ OF PRINCIPAL SPILLWAY

CONSTRUCTION DETA

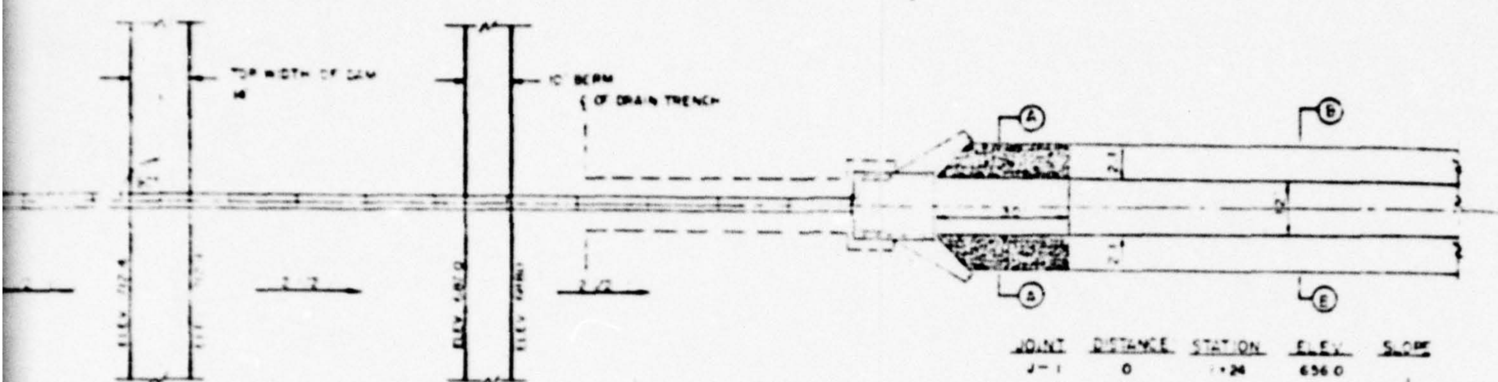
1 Rock Riprap Shall Be well Grad
Minimum Size Of 6" To A Maxi
Of 18" With At Least 50% B

2 Bedding Shall Meet The Gradi
Requirements Of Coarse Drain

0 5 10 20

SCALE IN FEET

1



SECTION B-B

JOINT	DISTANCE	STATION	ELEV.	SLOPE
J-1	0	1+24	656.0	
J-2	16	1+40	655.8	
J-3	32	1+56	655.6	
J-4	48	1+72	655.4	
J-5	64	1+88	655.2	
J-6	80	2+04	655.0	
J-7	96	2+20	654.8	
J-8	112	2+36	654.6	
J-9	128	2+52	654.4	
J-10	144	2+68	654.2	
J-11	160	2+84	654.0	
J-12	176	3+00	653.8	
J-13	192	3+16	653.6	
J-14	208	3+32	653.4	
J-15	224	3+48	653.2	
J-16	240	3+64	653.0	
J-17	256	3+80	652.8	
J-18	272	3+96	652.6	
J-19	228	4+12	652.4	
J-20	304	4+20	652.2	
J-21	320	4+44	652.0	
OUTLET	336	4+60	652.0	

SLOPE: S = 0.0125 '/' OR 0.2/16' JOINT

NOTE

Pipe Supplier's, Coat Outside Of Spigot Joint With Concrete On 16' Joint For Outlet.

NOTE

Dimensions For Pipe Lengths Are Based On Nominal Lengths And Do Not Include Creep.

COLLAR	DISTANCE	STATION	ELEVATION
I	20	1+44	655.75
II	44	1+68	655.45
III	68	1+92	655.15
IV	92	2+16	654.85
V	116	2+40	654.55
VI	140	2+64	654.25
VII	164	2+88	653.95
VIII	188	3+12	653.65
IX	212	3+36	653.35
X	236	3+60	652.75
XI	260	3+84	652.75

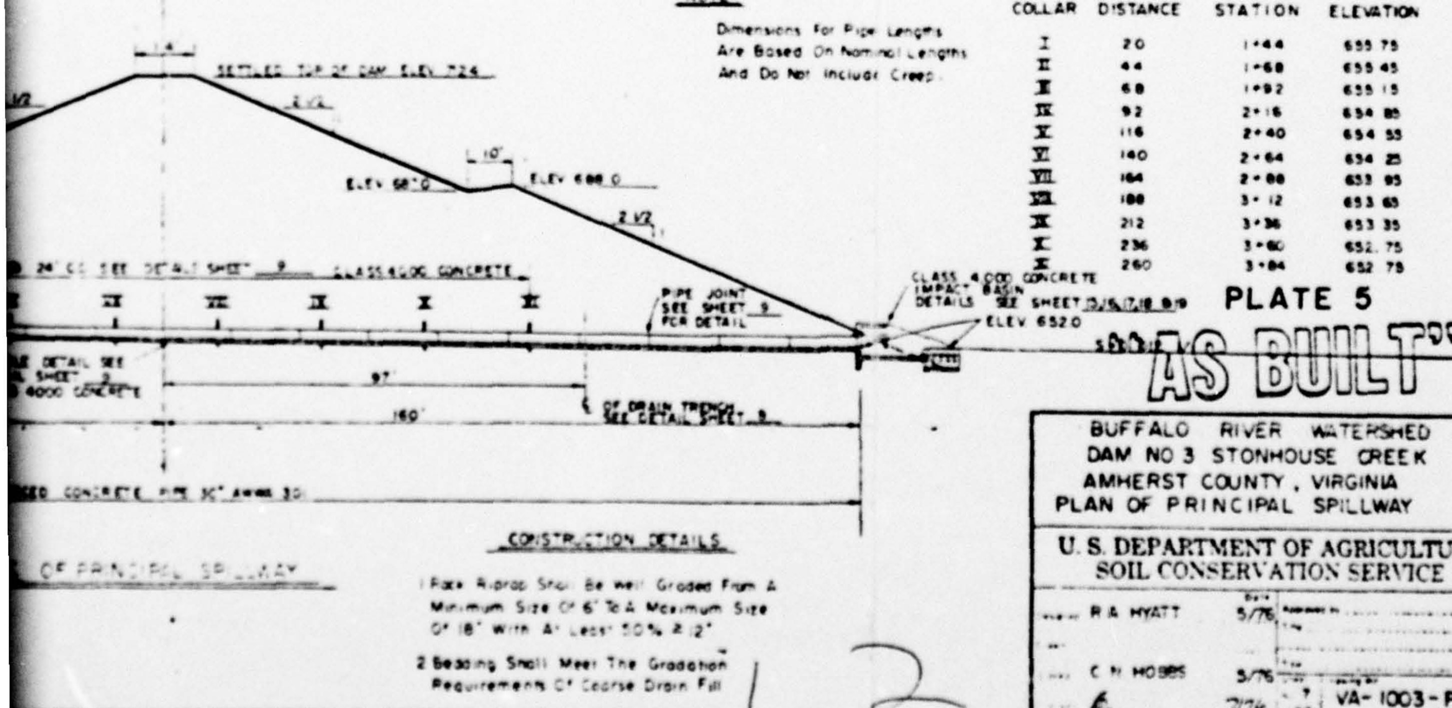


PLATE 5

"AS BUILT"

CONSTRUCTION DETAILS

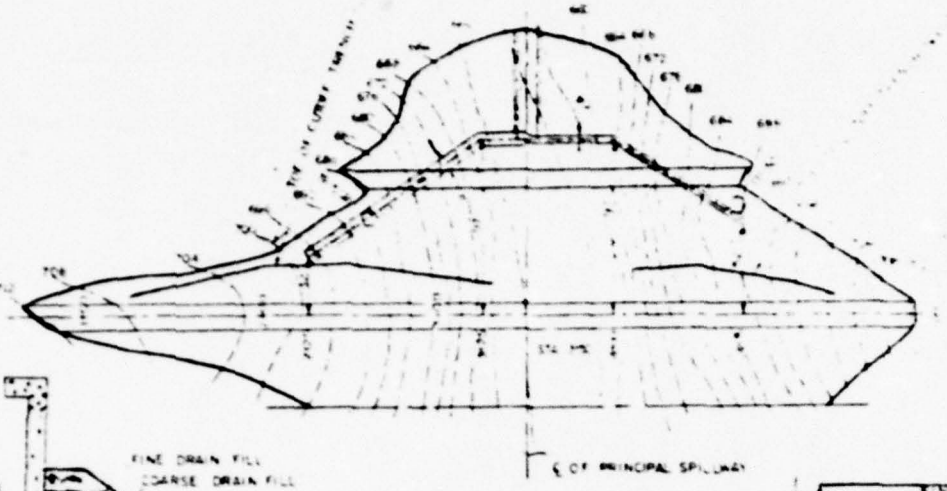
1. Rock Riprap Shall Be well Graded From A Minimum Size Of 6" To A Maximum Size Of 18" With At Least 50% ≥ 12"
2. Bedding Shall Meet The Gradation Requirements Of Coarse Drain Fill

1 2

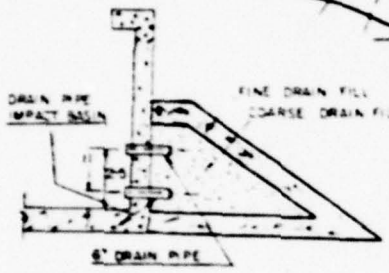
BUFFALO RIVER WATERSHED
DAM NO 3 STONHOUSE CREEK
AMHERST COUNTY, VIRGINIA
PLAN OF PRINCIPAL SPILLWAY

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

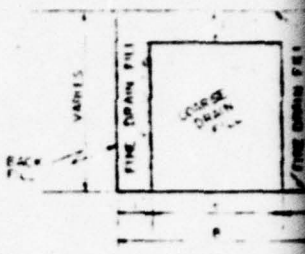
R.A. HYATT	5/76	
C.N. HOBBS	5/76	
	7/76	7 / 26 VA-1003-P



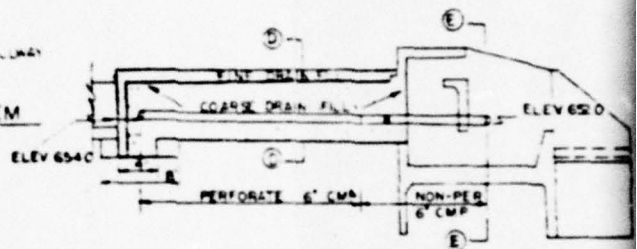
PLAN VIEW OF DRAINAGE SYSTEM



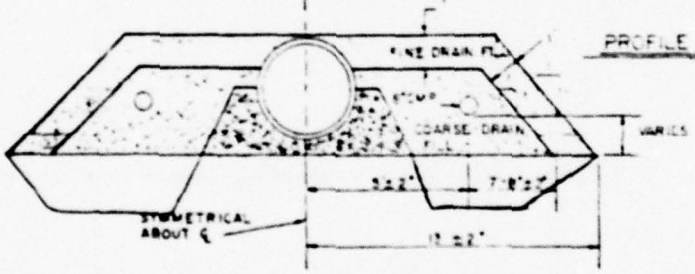
SECTION E-E



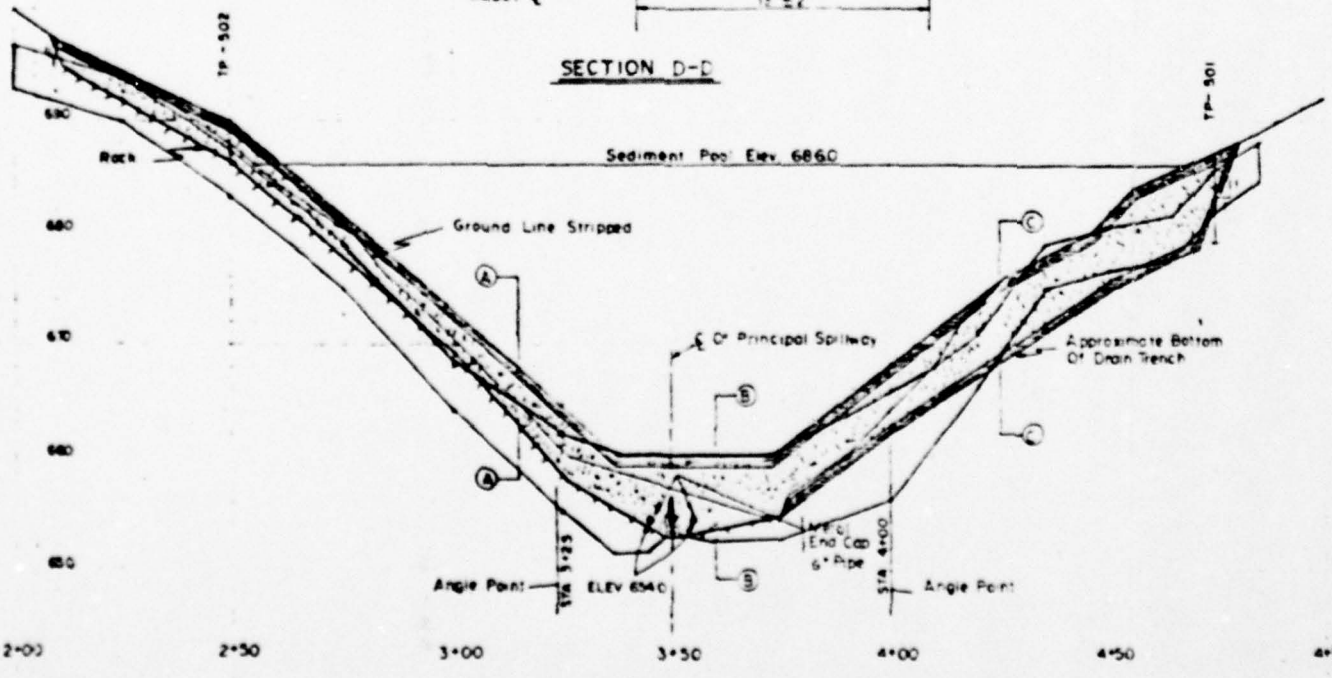
SECTION A-A



PROFILE OF OUTLET FOR DRAINAGE SYSTEM



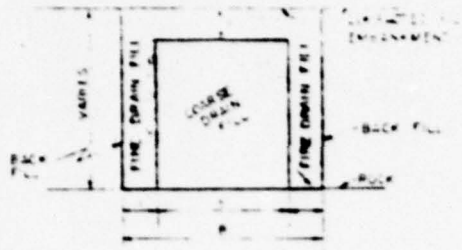
SECTION D-D



PROFILE ALONG CENTERLINE OF DRAINAGE SYSTEM TRENCH

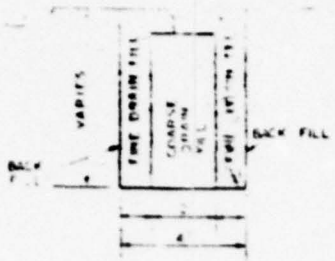
STATIONING ALONG ℄ OF DAM

1



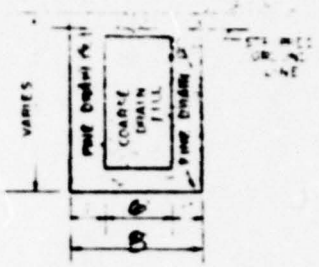
SECTION A-A

FROM PRINCIPAL SPILLWAY STA 3+50 TO STA 3+25 LEFT ABUTMENT

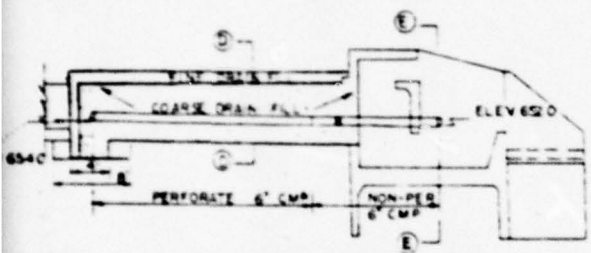


SECTION B-B

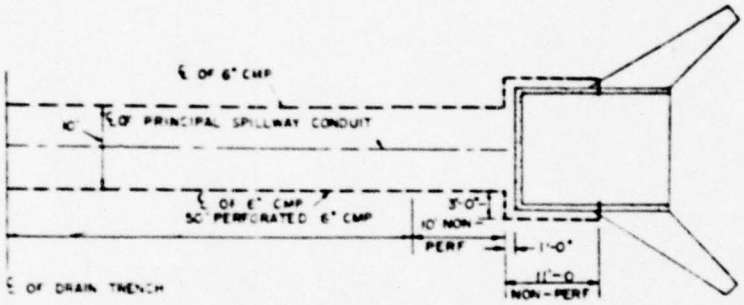
FROM PRINCIPAL SPILLWAY STA 3+50 TO STA 3+75



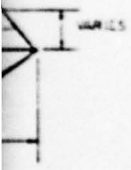
SECTION C-C

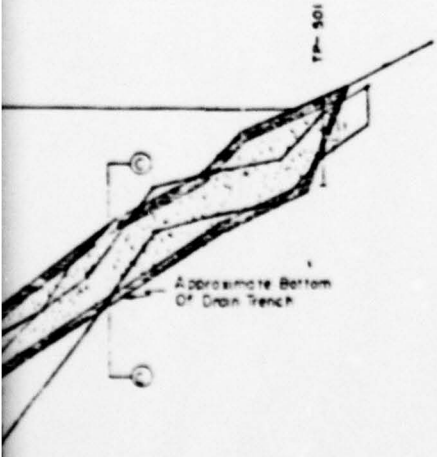


PROFILE OF OUTLET FOR DRAINAGE SYSTEM



PLAN OF DRAIN OUTLET





Angle Point

4+50

4+75

EM TRENCH

1

DESIGN DATA FOR DRAIN FILL AND IMPACT BASIN

1. COARSE CONCRETE AGGREGATE WA. SIZE NO 78, USED FOR COARSE DRAIN FILL

SIEVE NO	% PASSING
3/4"	MIN - 100
1/2"	90 - 100
3/8"	40 - 80
#4	0 - 20
#8	0 - 8
#16	0 - 3

2. FINE CONCRETE AGGRE ASTM C-33 USED FOR FINE DRAIN FILL

SIEVE NO	% PASSING
3/8"	MIN - 100
#4	95 - 100
#8	80 - 100
#16	50 - 85
#30	25 - 60
#50	10 - 30
#100	2 - 10
#200	0 - 3

PLATE 6

"AS BUILT"

NOTE

The Excavation Limits Are Approximate And Will Be Adjusted In Accordance With Conditions Encountered

QUANTITIES This Sheet Only

Coarse Drain Fill ~~---~~ Cu Yds } Total 640.0 Cu. yd.
Fine Drain Fill ~~---~~ Cu Yds }
6" Corrugated Metal Pipe, Perforated 100 Ft.
6" Corrugated Metal Pipe, Non-Perforated ~~42~~ Ft.
Small Animal Guards (See Sheet 16 For Details) 2
Metal End Caps 2
90° Elbows 6

1

2

BUFFALO RIVER WATERSHED
DAM NO 3 STONEHOUSE CREEK
AMHERST COUNTY, VIRGINIA
DRAINAGE SYSTEM DETAILS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R. A. HYATT	Date 5/76	Approved by
Drawn		Title
Traced C. N. HOBBS	5/76	Date
Checked RAH	7/76	Sheet No 8 of 26 — VA-1003-P

APPENDIX II

PHOTOGRAPHS

CONTENTS

Note: Photographs were taken on 24 May 1979.

NAME OF DAM: BUFFALO RIVER No. 3

BUFFALO RIVER No. 3 DAM

PHOTO 1. Upstream Face of Dam Showing Tall Weeds in Grass

PHOTO 2. Downstream Face of Dam Showing Tall Weeds and Bench

PHOTO 3. Junction of Dam and Right Abutment (Upstream Slope) Showing Erosion Gullies Adjacent to Rock Slope Drain

PHOTO 4. Junction of Dam and Left Abutment with Rock Drain on Downstream Slope

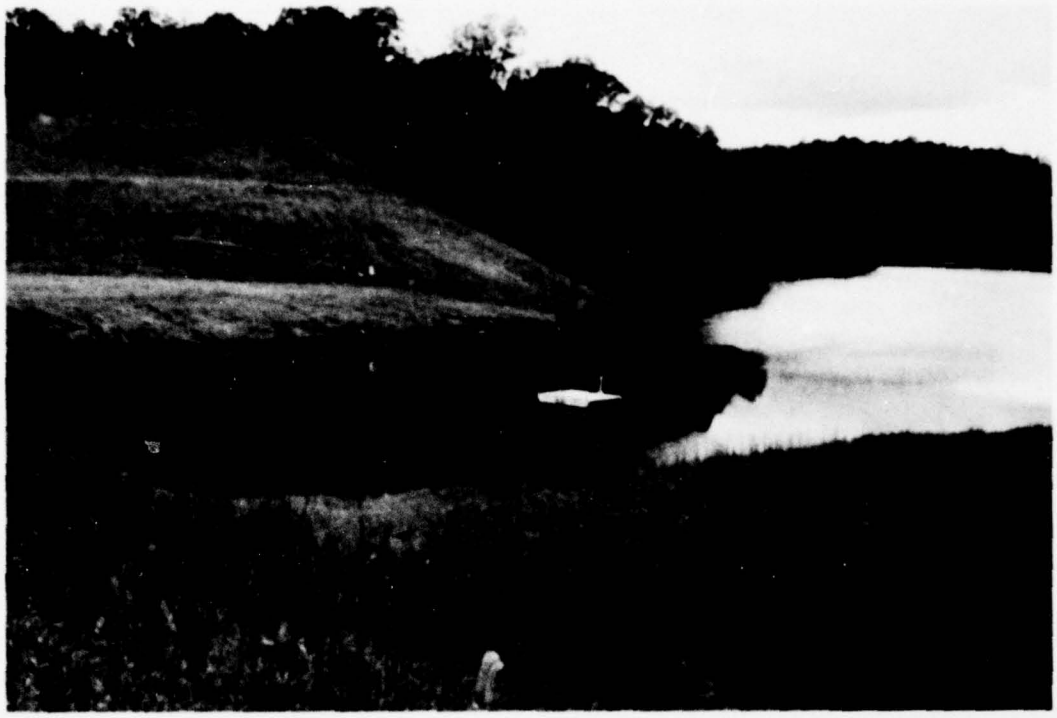


PHOTO 5. View of Riser, Reservoir and Approach Slope of Emergency Spillway (Note Erosion Gullies in Approach Slope)

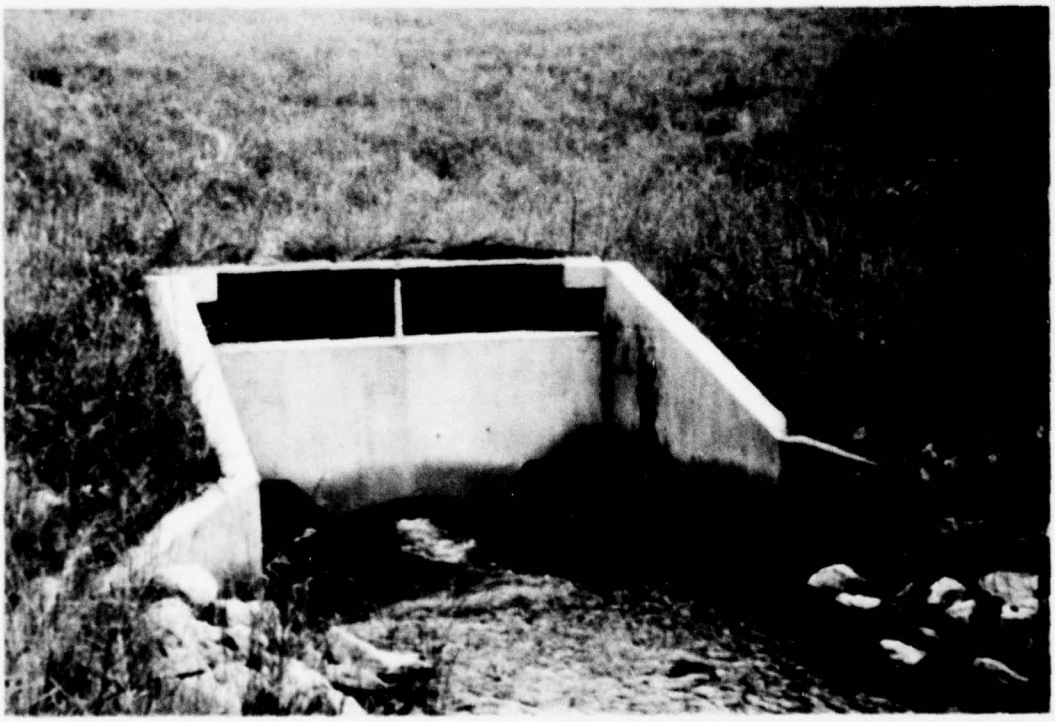


PHOTO 6. Impact Basin with Baffle Wall and End Sill

PHOTO 7. Vehicle Tracks in Emergency Spillway and on Crest of Dam

PHOTO 8. Stilling Basin and Downstream Channel

APPENDIX III

CHECK LIST - VISUAL INSPECTION

Check List
Visual Inspection
Phase I

Name of Dam Buffalo River No. 3 County Amherst State Virginia Coordinates Lat. 3740.4
Long. 7907.2

Date of Inspection 24 May 1979 Weather Cloudy Temperature 65°F.

Pool Elevation at Time of Inspection 686.1 ft. M.S.L. Tailwater at Time of Inspection 652.4 ft. M.S.L.

Inspection Personnel:

Virginia Water Control Board:
R. Gay

Michael Baker, Jr., Inc.:
T. W. Smith
J. M. Thompson
W. L. Sheafer

Owner's Representatives:
R. J. Mayo, Amherst County Administrator

Soil Conservation Service:
W. G. Friend

W. L. Sheafer Recorder

EMBANKMENT

Name of Dam: BUFFALO RIVER No. 3

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMANT AND ABUTMENT SLOPES	No sloughing was visible on the embankment and abutment slopes. Minor erosion, as evidenced by shallow gullies (0.5 ft.-1 feet. deep), were observed in the following locations: upstream left abutment slope drain, adjacent to the rock gutter at the right upstream abutment, just above the downstream slope bench and adjacent to the rock gutter, and below the bench at the right abutment.	The erosion gullies do not appear to be a serious problem. They can be filled with compacted earth and seeded.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The vertical and horizontal alignment coincides with the as-built drawings.	
RIPRAP FAILURES	There is no riprap on the dam.	There is no excessive erosion requiring riprap.

EMBANKMENT

Name of Dam: BUFFALO RIVER No. 3

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The slopes are 2.5:1 except for 3.5:1 below the bench on the upstream side. There are a few minor bare areas (2 ft. dia.) and vehicle tracks across the crest. Scattered small areas of dead grass were observed (5 ft. dia.). Dead tall weeds were interspersed with the grass in numerous areas. There is occasional draftwood on the shore.	These items can be repaired during regular maintenance.
CONSTRUCTION MATERIALS	Red clayey silt, brown sandy silt, and brown silty sand with little to some rock fragments were observed on the surface. The as-built drawings show Zone 1 core and cut off trench constructed of "plastic material" and Zone 2 in the outside shell consisting of "non-plastic material".	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	The junction of the embankment and abutments appears to be in red and brown clayey and sandy silts with rock fragments. Weathered granite and granite gneiss are indicated in the boring logs and geologic report at moderate to greater depths. No bedrock exposures were observed in the vicinity of the abutments. The natural ground between the open spillway and the dam at the right abutment consists of reddish brown sandy silt with rock fragments observed on the surface. There are rock gutters at the abutments (except for the upstream slope on the left side where erosion gullies have formed).	

EMBANKMENT

Name of Dam: BUFFALO RIVER No. 3

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	There was no noticeable seepage.	
STAFF GAGE AND RECORDER	None observed	A staff gage should be installed in the reservoir to monitor water levels above normal pool.
DRAINS	A 6 in. C.M.P. is shown on the as-built drawings on each side of the principal spillway conduit.	
FOUNDATION	Granite in the borings on the plans is generally shown to be at depths less than 10 ft. in the lowland. The soil consists of reddish brown clayey and sandy silt overlying silty sand, with rock fragments based on the borings and field observations. The key trench was designed to be excavated to firm bedrock.	

OUTLET WORKS

Name of Dam: BUFFALO RIVER No. 3

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	No severe cracking or spalling was observed on the end of the outlet conduit.	
INTAKE STRUCTURE	The concrete surface of the riser was in good condition, no spalling or cracking was observed.	
OUTLET STRUCTURE	The concrete surface of the impact basin was in good condition.	
OUTLET CHANNEL	The slopes of the channel are lined with stone riprap 30 ft. downstream from the impact basin. There are also rocks in the invert. A small stream (2 ft. wide) flows into the channel through the riprap from a gully on the left side.	
EMERGENCY GATE	A 30 in. slide gate is located on the riser and may be used to drain the reservoir.	

UNGATED SPILLWAY

Name of Dam: BUFFALO RIVER No. 3

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONTROL SECTION	The control section is 150 ft. wide and 30 ft. long with a crest elevation of 702.1 ft. M.S.L.	
APPROACH CHANNEL	There are two small erosion gullies near the beginning of the approach channel in red clayey and sandy silt with rock fragments. The adverse slope is approximately 2%.	The gullies should be filled with compacted earth and seeded.
DISCHARGE CHANNEL	Red, silt, sand, clay, and rock fragments were observed. There is adequate grass cover except in the vehicle tracks at the projected centerline of the dam and the earth road near the outlet. The discharge slope is approximately 2.5%.	The vehicle tracks should be covered and seeded.
BRIDGE AND PIERS	Not Applicable	
SLOPES	Red sandy and clayey silts with variable rock fragments were observed on the slopes cut at 3:1 on the left side and 2.5:1 on the right. Grass covers the slopes adequately except for vehicle tracks on the lower slope and a few minor erosion areas. There is an access road to the top of the cut along the tree line. Bedrock was not encountered.	Grass should be planted in the tracks and bare areas where possible.

INSTRUMENTATION

Name of Dam: BUFFALO RIVER No. 3

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	Bench marks noted on the as-built drawings were not located in the field.	
OBSERVATION WELLS	None observed	
WEIRS	None observed	
PIEZOMETERS	None observed	
OTHER		

RESERVOIR

Name of Dam: BUFFALO RIVER No. 3

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The slopes are gentle to moderately steep in reddish brown sandy and clayey silts with rock fragments. Exposures of bedrock were not observed. The slopes are mostly wooded with a few flat open grass covered areas adjacent to the shoreline.	
SEDIMENTATION	No serious sedimentation was observed which would deter the proper operation of the dam and reservoir.	

DOWNSTREAM CHANNEL

Name of Dam: BUFFALO RIVER No. 3

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel was in good condition with no obstructions or debris.	
SLOPES	The slopes are well formed in reddish brown clayey and sandy silt with rock fragments. There are scattered small seeps in the banks, mostly on the left side.	
APPROXIMATE NO. OF HOMES AND POPULATION	Several buildings and homes are located within 2 mi. downstream of the dam .	
CHANNEL	The invert of the channel is primarily covered with loose rocks. Weathered granite is partially exposed.	

APPENDIX IV

CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: BUFFALO RIVER No. 3

ITEM	REMARKS
PLAN OF DAM	The plan of dam is shown on the as-built drawings and is included in this report as Plates 2 and 3.
REGIONAL VICINITY MAP	The vicinity map is presented in this report as the Location Plan.
CONSTRUCTION HISTORY	The contractor and completion date were obtained from the as-built plans. The dam was constructed by Hazme Bros., Inc. in 1978.
TYPICAL SECTIONS OF DAM	The typical sections are included in the as-built drawings and are presented in this report as Plate 4.
HYDROLOGIC/HYDRAULIC DATA	Hydrologic and hydraulic calculations were available.
OUTLETS - PLAN and - DETAILS	Shown on the as-built drawings.
- CONSTRAINTS and - DISCHARGE RATINGS	Contained in the hydrologic/hydraulic calculations.
RAINFALL/RESERVOIR RECORDS	No rainfall or reservoir records are available at the dam.

Name of Dam: BUFFALO RIVER No. 3

ITEM	REMARKS
DESIGN REPORTS	Design Reports were obtained from the SCS.
GEOLOGY REPORTS	Data on detailed geologic investigations are contained in the Design Report and included in Appendix VII.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS	Hydrology and hydraulic calculations were available for the inspection report.
DAM STABILITY SEEPAGE STUDIES	Stability and seepage analyses were available for this inspection report and are included in Appendix VI.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Test pit and boring records, compaction curves, and results of laboratory analyses were printed in the as-built drawings and/or in the Detailed Geologic Report.
POST-CONSTRUCTION SURVEYS OF DAM	No known post-construction surveys were found.
BORROW SOURCES	Borrow sources in the reservoir area are shown on the as-built plans and are discussed in the Design Report.

Name of Dam: BUFFALO RIVER No. 3

ITEM	REMARKS
MONITORING SYSTEMS	No monitoring systems have been provided.
MODIFICATIONS	Data obtained during the inspection agrees closely with the as-built drawings, indicating that no major modifications were made other than modifications recorded on the as-built drawings.
HIGH POOL RECORDS	None available
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	No prior accidents or failure of the dam have been noted.
MAINTENANCE OPERATION RECORDS	Annual inspections were conducted by the SCS and County personnel.. Copies of the reports are included in Appendix V.

Name of Dam: BUFFALO RIVER No. 3

ITEM	REMARKS
SPILLWAY PLAN, SECTIONS and DETAILS	Information contained in the as-built drawings.
OPERATING EQUIPMENT PLANS & DETAILS	Information contained in the as-built drawings.

APPENDIX V

OPERATION AND MAINTENANCE INSPECTION REPORTS

CHECK LIST FOR SAFETY INSPECTION OF DAMS

Ref: Advisory ENG VA-31 Dec. 29, 1977

Site Buffalo River #3 Inspection Date JAN 1979

1. Embankment

   a. Settlement
   None

   b. Slope Stability
   Good

   c. Seepage
   None

   d. Drainage Systems
   OK

   e. Slope Protection
   Water Running down side of Gutter
   Lt Side Top of Dam being used as

2. Principal Spillway
   a. Riser Concrete Rod
   OK

   b. Trash Racks
   OK

   c. Control Gates & Operating Machinery
   OK

d. Conduit

OK

e. Cradle & Bent

OK

f. Stilling Basin or Impact Basin

Good

g. Outfall Channel

Good

3. Emergency Spillway

a. Approach & Outlet Channels

OUTLET Good

SMALL WASHES FRONT

b. Level Section

OK

c. Cut and/or Fill Slopes

Good

Vehicles HAVE CUT SLOPE IN SEVERAL PLACES APPEAR TO BE HEALING

4. Borrow Areas

Good.

5. Reservoir

a. Shoreline

Good

b. Sedimentation

None

c. Potential Upstream Hazard Areas

NONE

d. Watershed Runoff Potential

SAME AS DESIGNED

6. Maintenance

Warren G. Friend

SUBJECT

WS - Buffalo River Sites 2 & 3

E. R. Simmons

(WRITE CONCISE MESSAGE. SIGN AND FORWARD PARTS 1 AND 2 TO ADDRESSEE. RETAIN PART 3)

Have you looked at Buffalo River structures # 2 and # 3 to determine if any vegetative work needs to be done this fall?

The seeding season is almost here and considering the time required to contract for work, plans should be under way to get it done.

8341

FROM

(USE THIS SPACE FOR REPLY. SIGN AND DATE. RETURN PART 2 TO SENDER. RETAIN PART 1)

I have looked at the Buffalo River Structures to determine the extent of needed vegetative work.

Site #3 (Stonehouse) - Cover is excellent! Does need fertilizer, especially on the spillway and spillway slopes. No reseeding necessary. Three or four small gullies need some hand repair. Can do this with AID.

Site #2 (Thrashers) - Cover is generally adequate. There are three relatively small areas of very limited vegetation where the grading was done in the Spring; however, this is the area that will be torn up for the access road, and it does not seem reasonable to plan any revetation. In spots much of the cover is annual - lespedeza, ryegrass, and weeds . It is difficult to tell what percentage of the cover is actually prennial. There is considerable seeding from the mature grasses (both ryegrass and fescue) and this should provide even more dense cover. Even if this provides mainly mulch, it should stabilize the area. It seems that additional fertilization might be in order, but I question the advisability of doing any re-seeding.

I will discuss this in more detail with you on Wednesday.

FROM

DATE 8/4/78

FORM AD-311 (REV 5-68)

APPENDIX VI

STABILITY ANALYSES

SOIL CONSERVATION SERVICE - [illegible]

[illegible] "C" Street, Lincoln, Nebraska [illegible]

SUBJECT: ENG 13-18, Virginia WF-08, Buffalo River, Site 3 DATE: February 5, 1976
(Amherst County)

TO: Louis S. Button, Jr.
State Conservation Engineer
Soil Conservation Service
Richmond, Virginia

ATTACHMENTS

1. Form SCS-ENG-354, Soil Mechanics Laboratory Data, 3 sheets
2. Form SCS-ENG-125 & 125A, Consolidation Test Data, 2 tests, 6 sheets
3. Form SCS-127, Soil Permeability, 2 sheets
4. Form SCS-ENG-355A & 355B, Triaxial Shear Test Data, 3 tests, 6 sheets
5. Form SCS-ENG-352, Compaction and Penetration Resistance, 4 sheets
6. Form SCS-ENG-357, Summary - Slope Stability Analysis, 2 sheets
7. Investigational Plans and Profiles, 10 sheets

INTRODUCTION

The proposed 56-foot high embankment is a Class "c" hazard structure located in the Inner Piedmont physiographic area of west central Virginia.

The left abutment has a considerable zone of highly pervious bedrock at a shallow depth. The right abutment has a smaller pervious zone in the upper portion of the weathered bedrock that is covered with 5 to 50 feet of less permeable residual soil.

DISCUSSION

FOUNDATION

A. Classification. The 150-foot wide floodplain has up to 7.5 feet of silty, sandy and gravelly alluvium overlying granite bedrock. The four undisturbed floodplain samples from the principal spillway alinement are nonplastic SM and ML with 48% to 55% fines, and low-plasticity ML with 58% fines.

The two residual samples from test hole No. 2 at dam ℄ station 5+00 in the lower right abutment varied from MH for the shallow sample (from 1 to 4.5 feet deep) to nonplastic ML for the deeper sample (from 4.5 to 11 feet deep).

The upper abutments and the uplands have deep residual soils over highly weathered and fractured bedrock. The left abutment has a 10 to 22-foot deep zone of highly weathered bedrock under the 5 to 6 feet of residual soil. An open void was reported at depths of 12 to 16 feet.

of 98.0 pcf at an optimum moisture content of 24%. The nonplastic micaceous ML residuum from the emergency spillway area yielded a maximum dry density of 89.5 pcf at an optimum moisture content of 28.5%.

C. Shear Strength. Consolidated undrained triaxial shear tests were made on three samples to cover the range of borrow materials. The MH, moderately plastic ML, and the nonplastic micaceous ML were tested. The 1.4-inch diameter test specimens were molded slightly wet of optimum to 95% of Standard Proctor density. The test specimens were backpressured on the shear machine to full saturation, and pore-pressure measurements were made during shear testing to determine the effective stress shear parameters.

The shear test results are summarized in the following table:

Sample No.		Unified Class	LL	PI	Test Density	Shear Parameters			
						Total Stress		Effec. Stress	
Field	Laboratory					ϕ deg.	c psf	$\bar{\phi}$ deg.	$\bar{c}$ psf
206-1	76B-31	ML	Non-Plastic		85.2	18.5	1700*	35.0	50
101-1	35	MH	57	22	93.3	14.5	1400*	30.5	300
105-1	37	ML	46	16	93.2	16.0	800	34.5	75

*Negative pore pressures developed during shear testing.

D. Consolidation. The volume change measurements of the shear test specimens during the consolidation phase of shear testing indicate the compacted embankment materials at 95% of Standard Proctor density will have a consolidation potential of approximately 4% at the base of the 52-foot high floodplain section.

STABILITY ANALYSIS

An embankment-only analysis was made of the 56-foot high maximum section of the proposed Class "c" hazard embankment. It was assumed any weak alluvium in the shallow, narrow floodplain will be removed from under the entire dam.

Only the effective stress shear parameters were used in the analysis because extremely high total stress shear parameters were obtained in 2 of the 3 shear tests, due to the high negative pore pressures that developed.

The weakest failure arc is quite shallow for the full drawdown analysis of the upstream section using the effective stress shear parameters in the micaceous nonplastic ML shell zones. This situation is quite similar to the situation for a material with a zero "c" shear parameter in which the weakest arc in a stability analysis is at the surface. The infinite slope analysis applies for this shallow sloughing-type failure. For this site a 3½:1 slope below the permanent pool elevation (667.6) and 2½:1 slope above the berm are needed to obtain a safety factor of 1.35 for the full drawdown case.

The steady seepage analysis of the 2½:1 downstream slope with a drain at c/b = 0.6 yielded a safety factor of 2.1. The safety factor decreased to 1.55 when an acceleration factor of 0.1 G was applied for the seismic analysis.

SETTLEMENT ANALYSIS

The residual embankment settlement for the proposed 56-foot high embankment is expected to be less than a foot at the end of construction.

SEEPAGE ANALYSIS

For the seepage analysis of the left abutment it was assumed the highly permeable bedrock down to and below the void would be grouted or removed in the core section down to the less permeable rock at depths of 12 to 22 feet. It was further assumed that this underlying weathered bedrock in the abutments and the residual micaceous soils in the upper abutments have permeability rates of 1.0 fpd for a horizontal distance of 120 feet into the abutment. The right abutment was assumed to have a 140-foot wide zone of permeable bedrock and residual soils with an average permeability rate of 2.0 fpd. The underseepage below the dam in the floodplain was assumed to be negligible. — left abutment

The seepage rate through the abutments around the proposed dam was calculated to be approximately 0.1 cfs assuming the highly pervious rock zone and void in the left abutment and the shallow, highly pervious zone in the right abutment are both cut off. The calculated seepage loss through the right abutment was double that of the left abutment. 0.2 cfs right abutment

RECOMMENDATIONS

A. Site Preparation. Complete removal of all the alluvium under the dam in the narrow floodplain section is recommended due to the uncertainties of the shear strength of the highly variable alluvial deposits. Removal of the weak alluvium will eliminate any possibilities of translatory types of slope failure due to a weak foundation.

B. Centerline Cutoff. A deep cutoff down through the highly permeable bedrock and the void in the left abutment is recommended. This may be accomplished with either grouting or removal of rock and backfilling with compacted CL material. In the right abutment a 40-foot wide cutoff extending down into the weathered bedrock is recommended in the lower right abutment, and normal width above the rock line. A 4- to 6-foot deep cutoff should be sufficient in the deep residual soils in the upper abutment above the permanent pool elevation.

Backfill with the ML or MH material and compact to a minimum density of 95% of Standard Proctor density.

C. Principal Spillway. Pipe elongation is not expected to be a problem if the alluvium is removed from under the dam.

D. Drainage. A blanket drain or a toe drain placed on the bedrock is recommended up to the emergency spillway elevation in the left abutment, across the floodplain, and up to permanent pool elevation in the right abutment to provide an outlet for seepage that bypasses the centerline cutoff. Well-graded, clean, durable sand and gravel should provide adequate drain material for the moderately plastic residual soils.

E. Embankment Design. The following are recommended:

1. Selectively place the plastic, fine-grained materials in the center section, and the nonplastic materials in the outer sections.

2. Compact the embankment materials to a minimum density of 95% of Standard Proctor (ASTM D-698, Method A).

3. Provide a 2½:1 over 3½:1 upstream slope with a 10-foot berm at elevation ~~687.6~~ 688 and 2½:1 downstream slopes with a 10-foot berm at elevation 684.5.

4. Provide an overfill of 1.0 foot across the floodplain to compensate for residual embankment and foundation settlement after construction is complete.

Prepared by:

Edgar F. Steele
Civil Engineer

Reviewed and Approved by:

Lorn P. Dunnigan
Head

Attachments

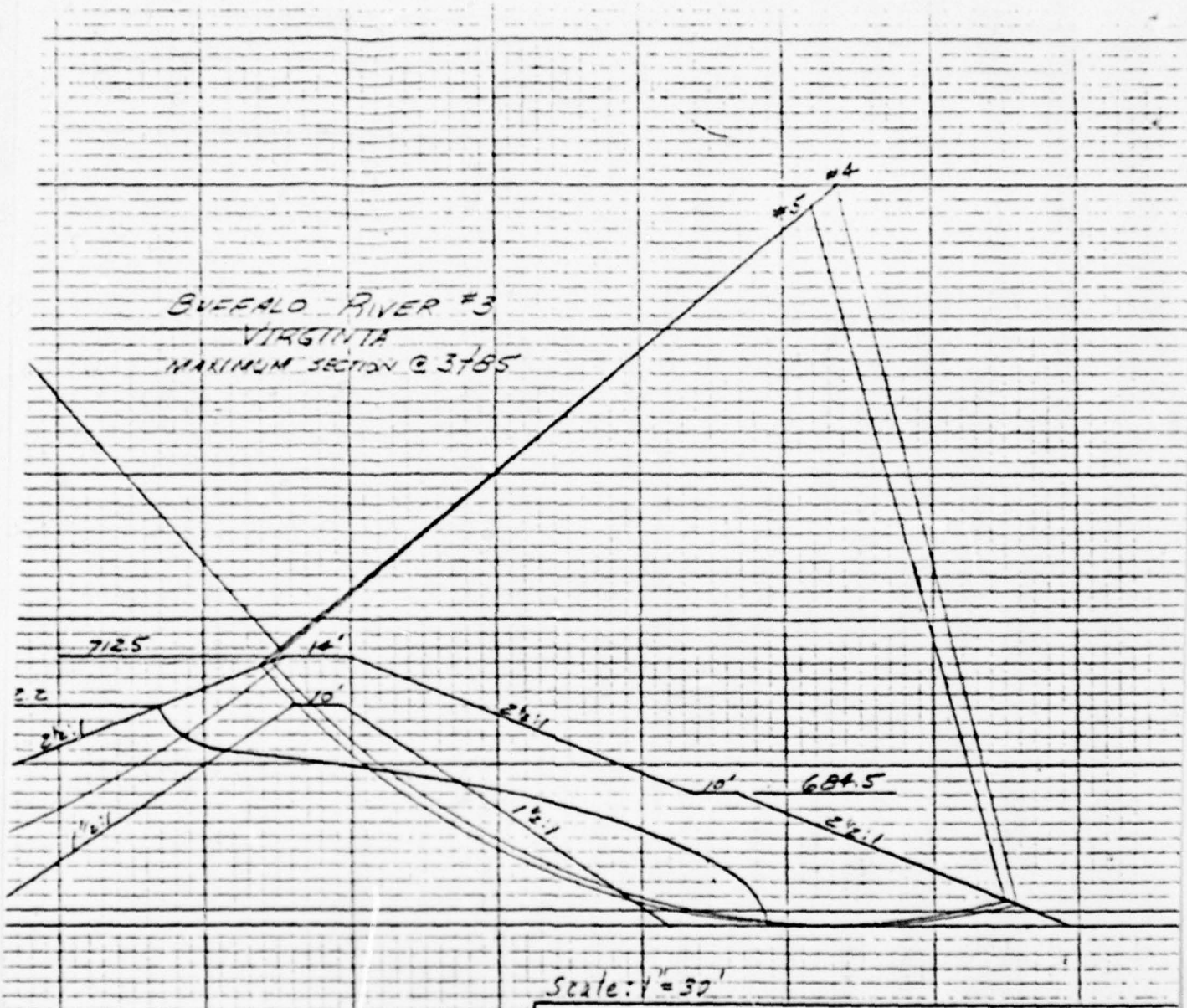
cc: Louis S. Button (2)
Arthur B. Holland, Broomall, PA

	SOURCE AND USE OF MATERIALS	CLASSIFICATION	ADOPTED DESIGN DATA γ_d (pcf)	γ_m (pcf)	γ_{sat} (pcf)	γ_{sub} (pcf)	ϕ (deg)	$\tan\phi$	c (psf)	REMARKS
①	EMBANKMENT (SHELL)	ML	95.1	109.5	118.0	55.5	19.5	.335	1700	
②							35	.700	50	
③	EMBANKMENT (CORE)	ML	93.2	115.5	121.5	59.0	16	.287	800	
④							34.5	.687	75	
⑤	EMBANKMENT (CORE)	MH	93.2	115.5	121.5	59.0	14.5	.259	1400	
⑥							30.5	.589	300	
⑦										
⑧										

TRIAL NO.	SLOPE	CONDITIONS	F_s Bishop	F_s Swedish Circle
		MAXIMUM SECTION @ 3+85		
		UPSTREAM – FULL DRAWDOWN, DOWNSTREAM – STEADY SEEPAGE		
1 UP	2½:1/3:1	SHELL (35°-50), CORE (24.5°-75), 10' BERM @ 687.6	1.16	1.22
2 UP	2½:1/3½:1	" " " " " "	1.35	1.41
3 UP	3½:1/4:1	" " " " " "	1.46	1.49
4 DN	2½:1	" " " " 10' BERM @ 684.5, DRAIN @ EL 670.6	2.1	1.98
5 DN	2½:1	" " CORE (30.5-300), " " " " "	2.1	2.0
4A DN	2¾:1	SAME CONDITIONS AS TRIAL 4 WITH EARTHQUAKE FORCE OF .1G APPLIED	1.55	1.46

VI-5

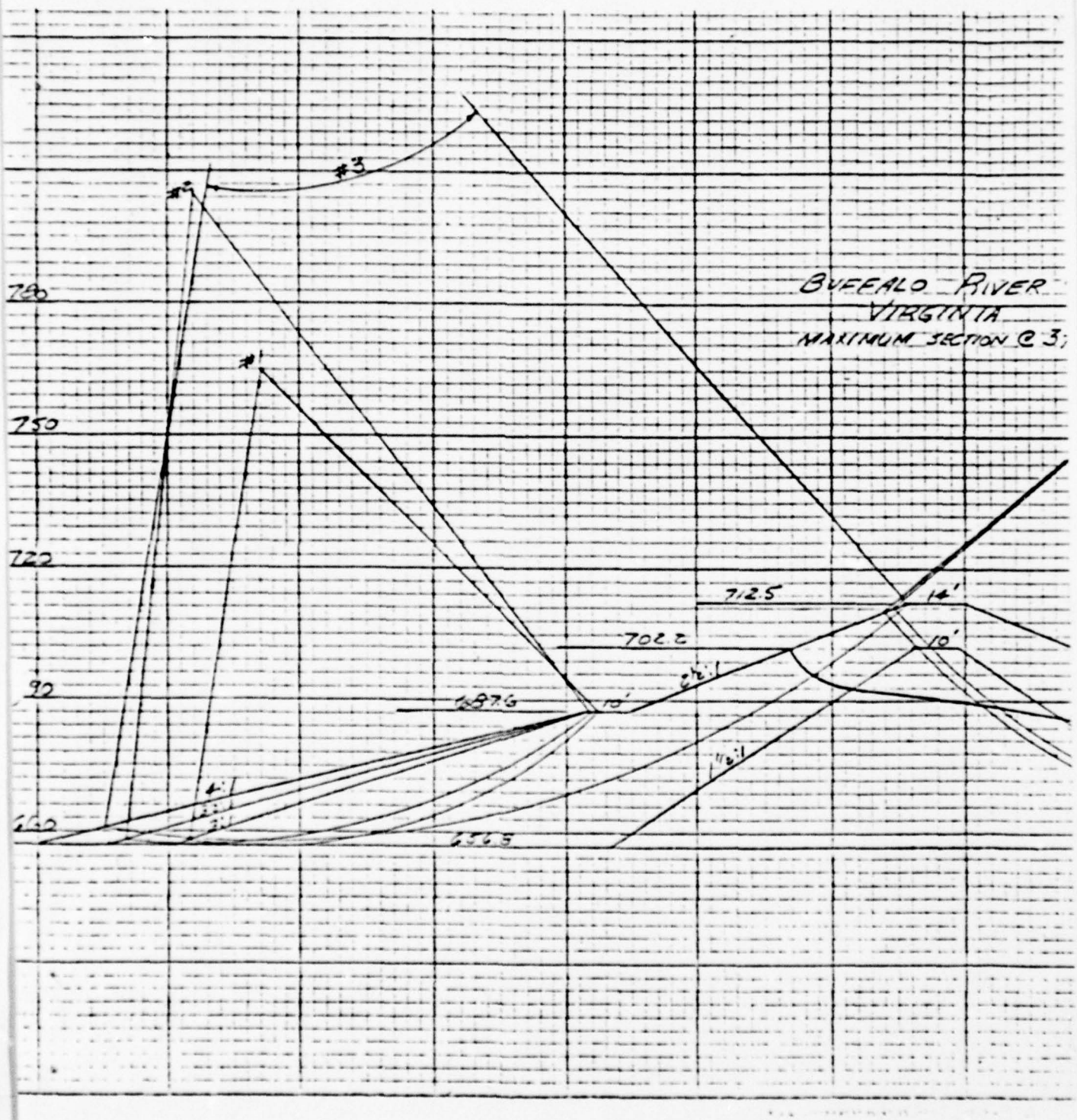
Sheet 1 of 2



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DESIGNED BY R.F.H	APPROVED BY
CHECKED BY A.W.L.	DRAWING NO.
DATE: 1-20-76	SHEET 2 OF 2

SCS-ENG-313A


#3
#2
#1
780
750
722
712.5
14'
702.2
10'
687.6
10'
2½:1
690
4:1
3:1
1½:1
675.5
BUFFALO RIVER
VIRGINIA
MAXIMUM SECTION @ 3

APPENDIX VII

GEOLOGIC REPORT

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

SUPPLEMENTAL
GENERAL

State Virginia County Amherst ; ¼ ¼ Sec. T R ; Watershed Buffalo River

Subwatershed Stonehouse Creek Fund class 08 (FP-2, WP-1, etc.) Site number 3 Site group I Structure class C

Investigated by T. Mack, Geologist (signature and title) Equipment used Failing truck mounted drill (Type, size, make, model, etc.) Date 11/75

SITE DATA

Drainage area size 4.99 sq. mi., 5193.6 acres Type of structure Earth Fill Purpose Recreation and flood control

Direction of valley trend (downstream) southeast Maximum height of fill 55.7 feet. Length of fill 450 feet.

Estimated volume of compacted fill required 64,900 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	374	41	26
Floodwater	1,030	91	45.4

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Inner Piedmont Topography steeply rolling Attitude of beds: Dip - Strike -

Steepness of abutments: Left 27 percent; Right 45 percent. Width of floodplain at centerline of dam 90 feet

General geology of site: This site was drilled in June 1975. This investigation showed shallow granite rock to occur in the floodplain and on the steep lower slopes of the abutments. Higher on the abutments deeply weathered granite is present.

A void occurs at depths that range from 12.5 to 17.0 from station 2+00 to station 3+00 on the dam centerline.

Methods and Procedures

1. The emergency spillway was changed from the left abutment to the right abutment. This was due to granite rock occurring 23.3 feet above grade in the cut on the left abutment. The proposed emergency spillway cut on the right abutment showed no rock to be present.

2. Permeability tests were taken into rock. The K factor was determined by subtracting

loss for that run.

3. Hand auger holes were used to investigate soils in the emergency spillway cut and in the borrow area.

Centerline of the Dam

The drill holes emplaced on the dam centerline showed shallow alluvial soil to be present in the floodplain. DH 21 showed alluvial ML, CL and GM material to occur here with the soil profile having a depth of 4.7 feet with weathered rock occurring to depth of 7.5 feet.

Shallow residual soil occurs on the lower slopes of the abutments. This ranges in depth from 2.0 feet on the left abutment to 6.0 feet on the right abutment with ML and SM material present.

Above permanent pool elevation on both abutments deep residual soil occurs. This soil has from 4.0 to 7.0 feet of yellow-red plastic ML material over brown-yellow and salt and pepper colored nonplastic SM. From 2.0 to 18.0 feet of weathered granite is present below the residual soil.

Impermeable rock occurs just below weathered rock at depth 7.5 in the floodplain. On the left abutment impermeable rock occurs at depths that range up to 52.0 feet. This is in DH 22 at station 1+45 centerline of the dam. On the steep left abutment that rises above the floodplain impermeable rock occurs at depth of 15.5 feet. This is in DH 25 at station 2+77 centerline dam.

A void occurs from station 2+00 to station 3+00 on the dam centerline. This void occurs from depth of 16.8 to 17.1 in DH 24 at station 2+38 on the dam centerline and at depth of 12.5 to 12.7 in DH 25 at station 2+77 on the dam centerline. At both locations the void took all the water that could be pumped down the hole.

On the right abutment impermeable rock occurs at depth of 20.0 feet on the steep slope next to the floodplain. This is in DH 28 at station 4+41 on the dam centerline. Further up the abutment impermeable to very slightly permeable rock occurs below depth of 40.0 feet. This is in DH 27 at station 5+50 centerline dam.

Unfractured rock occurs at shallow depth in the floodplain. Here it is at 10.7 feet in DH 21. On the abutments unfractured rock is at greater depths. It is below 66.0 feet on the left abutment and at 57.9 feet on the right abutment.

To investigate the centerline of the dam eight drill holes were emplaced. These are numbered DH 21 through DH 28.

Drill holes on the proposed pipe centerline showed weathered granite to occur upstream from the dam centerline. The greatest thickness of this weathered granite is 7.1 feet in DH 322 at station 1+52 on the pipe centerline.

Permeable rock occurs on the pipe centerline upstream from the centerline of the dam. In DH 321 permeable rock extends to depth of 28.8 feet. The remaining area on the pipe centerline generally has impermeable rock generally below the top of unweathered rock.

On the pipe centerline fractured rock extends to depths of 23.2 and 32.9 feet upstream from the dam centerline. These depths are shown in DH 322 and in DH 321. Downstream from the dam centerline fractured rock extends to shallower depths. Here in DH 323 fractured rock extends to depth of 15.0 feet.

To investigate the centerline of the pipe four drill holes were used. These are numbered DH 321 through DH 324.

Emergency Spillway

The emergency spillway was transferred from the left abutment to the right abutment due to rock occurring in a deeper cut on the left abutment.

On the right abutment the centerline of the emergency spillway crosses the dam centerline at station 6+62.centerline of the dam and station 3+50 on the centerline of the emergency spillway. These centerlines form a 90 degree angle.

No rock was found to be present in the proposed emergency spillway cut. The deep residual soil present has 4.0 feet of yellow-red hard plastic silt (ML or MH) present above approximately 4.0 feet of slightly plastic to nonplastic yellow-brown and red-brown SM. These These layers are over deep C horizon SM material that ranges in depth up to 23.8 feet. Weathered granite rock occurs below grade as encountered in DH 261 and DH 262.

To investigate the emergency spillway cut three drill holes were used. These are numbered DH 261 through DH 263. In addition seven auger holes were emplaced. These are numbered AH 271 through AH 277.

Borrow Area

Ten auger holes numbered AH 111 through AH 120 were placed to the left of the preliminary borrow area as investigated with backhoe test pits.

These showed that colluvial soil occurs on the slopes to the right of Stonehouse Creek. Upstream from this colluvium residual soil of the

Hayesville series is present. Alluvial soil with water present occurs in the floodplain.

The profiles of the colluvial and Hayesville soils have been described in the report on the preliminary borrow area.

U. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-[illegible]
REV. [illegible]
SHEET 1 OF 7

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

WATERSHED	SUBWATERSHED	COUNTY	STATE
Buffalo River	Stonehouse Creek	Amherst	Virginia

SITE NO.	SITE GROUP	STRUCTURE CLASS	INVESTIGATED BY: (SIGNATURE OF GEOLOGIST)	DATE
3	I	c	[illegible]	11/75

FOR INSERVICE USE ONLY

INTERPRETATIONS AND CONCLUSIONS

1. The highly permeable void that occurs from station 2+00 to station 3+00 on the dam centerline will have to be rendered impermeable. This could be either by excavation or by grouting. If it is decided to excavate to the void, the cutoff trench should be carried approximately two feet below the void to impermeable rock.

2. Consideration should be given to possible grouting of a permeable area in the right abutment as shown by DH 27. Depth of this area is from 29.0 feet to 35.0 feet.

3. Soils in the foundation should have sufficient strength to bear the embankment.

The weak ML and CL layers in the foundation are inextensive. With a floodplain approximately 100 feet wide excavation of the pipe trench should remove most of the weak alluvium.

The deep residual soils higher up on the abutments should have sufficient bearing strength as shown by the fairly high blow counts here.

4. The relief of top of rock along the centerline of the proposed pipe is irregular. Excavation of some of the rock downstream from the dam centerline should be considered. This is to obtain fairly uniform thickness in the clay cushion underlying the pipe.

5. The riser will be placed on weathered granite. This rock could be excavated to unweathered granite at elevation 649.1. However, hard rock was encountered at 5.5 foot depth in DH 322. Here there is a blow count of 50/.5 from depth of 5.5 to 6.0 feet.

6. No rock is expected to be present in the emergency spillway cut. The yellow-red plastic ML and MH material should be used in the core. The SM material could be considered for the shell. However, greater quantities of SM from the spillway cut will probably be available than needed. Also, less plastic core material is available from the cut than is required. This shortage of plastic material can be made up from the borrow area.

7. The borrow area should supply the needed fine-grained plastic material required for the cutoff and core. The colluvial soil should not be as highly plastic as the B horizon of the residual soil.

Authorized Buffalo River Site No. 3 State Virginia Prepared by Mack, T. Date 12/73

Representative Sample for Lab.			Represents Soils from				Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	Remarks
Field No.	Depth From-To	Unif. Class	Hole No.	Depth From-To	Unif. Class	Location			
101-1	1.0-7.5	ML	101	1.0-7.5	ML	Borrow Area	Core	14,000	Colluvia
			102	0.5-6.2	ML or MH				
			107	0.5-11.5	ML or MH				
101-2	7.5-10.0	SM or ML	101	7.5-10.0	SM or ML				
			102	6.2-7.3	ML				
			107	7.3-11.5	ML or SM				
-1	1.0-4.7	ML or MH	105	0.5-4.7	ML or MH	Borrow Area	Core	13,000	B horiz.
			103	0.5-3.3	ML				Hayesville series
			104	0.4-2.6	ML				
			106	0.5-2.8	ML				
			108	0.5-10.3	ML & CL				
			109	0.5-10.4	ML				
			110	0.5-11.0	ML & MH				
105-2	4.7-9.2	SM	105	4.7-9.2	SM	Borrow Area	Shell or Core	3,000	C Horiz.
			106	2.8-5.3	SM				Hayesville series

SCS EW Unit
Upper Darby, Pa.
January 10, 1962

Sheet 2 of 7 Va 1003-G

To accompany [illegible]

Watershed **Buffalo River** Site No. **3** State **Virginia** Prepared by **Mack, T.** Date **12/73**

Representative Sample for Lab.			Represents Soils from				Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	Remarks
Field No.	Depth From-To	Unif. Class	Hole No.	Depth From-To	Unif. Class	Location			
201-1	1.0-3.3	ML or MH	201	0.5-3.3	ML or MH	EMS	Core	15,000	B horiz. Hayesville series
			202	0.5-2.8	ML or MH				
			203	0.5-3.0	ML or MH				
			205	0.5-2.0	ML or MH				
			206	0.5-3.5	ML or MH				
			207	0.5-4.2	ML or MH				
			208	0.5-5.4	ML or MH				
			209	0.5-4.5	ML				
			211	0.5-3.9	ML				
			213	0.5-4.5	ML or MH				
			214	0.5-2.3	ML				
			231	0.5-7.0	ML or MH				
			232	0.5-6.5	ML or MH				
			233	0.5-6.6	ML or MH				
			234	0.5-6.1	ML or MH				
			235	0.5-7.0	ML or MH				
			236	0.5-5.6	ML or MH				
206-1	3.5-12.0	ML or SM	206	3.5-12.0	ML or SM	EMS	Shell	15,000	C horiz. Hayesville
			201	3.3-12.0	ML				
			202	2.8-12.6	ML				

SCS EWP Unit
Upper Darby, Pa.
January 10, 1962

Watershed Buffalo River Site No. 3 State Virginia Prepared by Mack, T. Date 12/70

Representative Sample for Lab.			Represents Soils from				Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	Remarks
Field No.	Depth From-To	Unif. Class	Hole No.	Depth From-To	Unif. Class	Location			
206-1 Cont'd.			~~207~~	4.2-12.9	ML or SM				
			~~208~~	5.4-12.0	ML or SM				
			~~209~~	4.5-9.0	ML				
			231	7.0-13.0	SM				
			232	6.5-11.0	SM				
			233	6.6-12.0	SM				
			234	6.1-13.0	SM				
			235	7.0-12.0	SM				
			236	6.6-12.0	SM				
						—		—	
~~211-1~~	4.5-11.6	SM	~~215~~	4.5-11.6	SM	EMS	Shell	15,000	
			~~203~~	3.0-12.0	SM				
			~~204~~	0.5-5.2	SM				
			~~205~~	2.0-4.2	SM				
			~~209~~	9.0-12.5	SM				
			~~210~~	0.5-4.4	SM or SC				
			~~211~~	3.9-11.5	SM				
			~~212~~	0.5-2.3	SM				
			~~213~~	4.5-11.6	SM				
			~~214~~	2.3-11.7	SM				

SCS [illegible] Unit
Upper Darby, Pa.
January 10, 1962

SUPPLEMENTAL

Watershed Buffalo River Site No. 3 State Virginia Prepared by Mack, T. Date 11/72

Representative Sample for Lab.			Represents Soils from				Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	Remarks
Field No.	Depth From-To	Unit. Class	Hole No.	Depth From-To	Unit. Class	Location			
101-1	1.0-7.5	ML	101	0.5-7.5	ML	Borrow Area	Core	14,000	colluvial
			111	0.5-7.0	ML				
			112	0.5-8.2	ML & CL				
			113	0.5-7.0	ML & CL				
101-2	7.5-10.0	SM or ML	101	7.5-10.0	SM or ML	Borrow Area	Shell	13,000	colluvial
			111	7.0-11.0	SM				
			112	8.2-8.6	SM				
			113	7.0-7.5	SM				
105-1	1.0-4.7	ML or MH	105	0.5-4.7	ML or MH	Borrow Area	Core	13,000	B horiz Hayesville series
			114	0.5-2.5	ML				
			116	0.5-3.0	ML				
			118	0.5-3.5	ML				
			120	0.5-2.3	ML				
105-2	4.7-9.2	SM	105	4.7-9.2	SM	Borrow Area	Shell	3,000	C horiz Hayesville series
			116	3.0-3.7	SM				
			118	3.5-4.0	SM				
			120	2.3-5.6	SM				

SCS FWP Unit
Upper Darby, Pa.
January 10, 1962

SUPPLEMENTAL

Watershed Buffalo River Site No. 3 State Virginia Prepared by Mack, T. Date 11/75

Representative Sample for Lab.			Represents Soils from				Purpose of Suggested Use	Est. Available Quantity Cu. Yds.	Remarks
Field No.	Depth From-To	Unif. Class	Hole No.	Depth From-To	Unif. Class	Location			
201-1	2.0-7.5	ML or MH	201	0.5-3.5	ML or MH	EMS	Core	15,000	B horiz Hayesville series
			261	0.5-3.0	SM				
			262	0.5-3.5	ML				
			263	0.5-4.0	ML				
			271	0.5-4.6	MH				
			272	0.5-5.5	ML				
			273	0.5-4.1	MH				
			274	0.5-4.1	ML or MH				
			275	0.5-4.2	ML				
			276	0.5-4.5	ML				
			277	0.5-4.5	MH				
206-1	5.5-12.0	ML or SM	206	5.5-12.0	ML or SM	EMS	Shell	15,000	C horiz Hayesville series
			261	3.0-11.2	SM				
			262	3.5-11.5	SM				
			263	4.0-9.0	SM				
			271	4.6-7.0	SM				
			272	5.5-8.9	SM				
			273	4.1-7.5	SM				
			274	4.1-7.2	SM				
			275	4.2-7.1	SM				
			277	4.5-6.5	SM				

SCS FOR 201
Mt. Holly, Pa.
January 10, 1962

SUPPLEMENTAL

Alternate Buffalo River Site No. 5 State Virginia Prepared by Mack, T. Date 11/75

Representative Sample for Lab.			Represents Soils from				Purpose or Suggested Use	Est. Avail. Quantity Cu. Yds.	Remarks
Field No.	Depth From-To	Unif. Class	Hole No.	Depth From-To	Unif. Class	Location			
213-1	4.5-11.6	SM	213	4.5-11.6	SM	EMS	Shell	15,000	C horiz Hayesville series
			261	11.2-34.0	SM				
			262	11.5-35.5	SM				
			263	9.0-36.0	SM				
			271	7.0-25.2	SM				
			272	8.9-12.0	SM				
			273	7.5-26.3	SM				
			274	7.2-19.5	SM				
			275	7.1-18.0	SM				
			276	4.5-20.5	SM				
			277	6.5-17.0	SM				

SCS CAP Unit
Upper Darby, Pa.
January 10, 1969

APPENDIX VIII

GENERAL REFERENCES

GENERAL REFERENCES

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